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# **THE REVIEW OF APPLIED ENTOMOLOGY.**

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BORUSIEWICZ (A.) & KAPUŚCIŃSKI (S.). **A Contribution to the Knowledge of the Distribution over Poland of destructive Arthropoda feeding on the Fruits and Seeds of the common Juniper (*Juniperus communis* L.).** [In Polish.]—*Prace roln.-leśn.* no. 40, [1+]22 pp., 1 fldg. map, 1 ref. Cracow, 1948. (With a Summary in English.)

First- and second-year fruits of juniper (*Juniperus communis*) were collected in forests in different parts of Poland, chiefly in 1945 and 1946, and examined for the presence of pests. Those found were *Eriophyes quadrisetus*, Thoms., *Diaspis visci*, Schr., *Chlorochroa juniperina*, L., *Argyresthia praecocella*, Zell., and *Megastigmus kuntzei*, Kapusciński [cf. *R.A.E.*, A 36 267-268]. Notes are given on their distribution in the various forest districts of Poland, which is also shown on a map, and the type of damage caused by each is described.

ADSUAR (J.). **Studies on Virus Diseases of Papaya (*Carica papaya*) in Puerto Rico. I. Transmission of Papaya Mosaic.**—*Tech. Pap. P.R. Univ. agric. Exp. Sta.* no. 1, [2+]10 pp., 5 figs., 14 refs. Río Piedras, P.R., 1946. **II. Transmission of Papaya Mosaic by the Green Citrus Aphid (*Aphis spiraeicola* Patch).**—*Op. cit.* no. 2, [1+]5 pp., 1 fig., 1 ref. **III. Property Studies of Papaya Mosaic Virus.**—*Op. cit.* no. 4, pp. [1+]7-11, 3 refs. (With Summaries in Spanish.)

Investigations in Porto Rico, reported in the first of these papers, have shown that papaya is affected there by three diseases, all thought to be caused by viruses. These are bunchy-top [cf. *R.A.E.*, A 28 494], which is the commonest, dieback, which is less common, and mosaic, which replaces these in a small area on the south coast. The mosaic disease is characterised by mottling and extreme distortion of the leaves and by the presence of green and brown rings on the fruits. In common with bunchy-top and dieback, it causes marked reduction of top growth and the sudden appearance of green streaks on the stem and young petioles, but, unlike them, it rarely affects the flow of latex. The virus was successfully transmitted by mechanical means.

In the second paper, experiments are described in which the mosaic virus was transmitted to healthy papaya by *Aphis spiraeicola*, Patch, which is a major pest of *Citrus* (in which it causes rosetting) in Porto Rico and was observed during a routine inspection on papaya, to which it appears to migrate during certain seasons. Of 33 healthy plants artificially infested with batches of 6-10 nymphs and winged adults that had fed on diseased papaya leaves for periods of 8-60 minutes, 15 developed symptoms of the disease, whereas all the controls, which were infested with Aphids collected directly from *Citrus*, remained healthy. This appeared to indicate that the Aphids are not viruliferous while on *Citrus* and that, if they are vectors of the disease in the field, they must acquire the virus during migration.

The third paper contains an account of investigations on the physical properties of the mosaic virus, including a test of its retention by *A. spiraeicola*. Four batches of five winged adults that had been starved for an hour and then fed for 15 minutes on infected papaya leaves were allowed to feed for three hours on healthy papaya seedlings and then transferred to further healthy plants. Three of the batches infected the first healthy plants, but none the second.

LEACH (J. G.) & BISHOP (C. F.). **Purple-top Wilt (Blue Stem) of Potatoes.**—*Bull. W. Va. agric. Exp. Sta.* no. 326, 35 pp., 16 figs. (1 col.), 24 refs. Morgantown, W. Va., 1946.

The literature on purple-top wilt (blue stem) of potatoes is reviewed, and an account is given of investigations begun in West Virginia in 1939, some of the

results of which have already been noticed [*R.A.E.*, A 31 275 ; 33 173], on its transmission and control. It is caused by the aster-yellows virus (*Chlorogenus callistephi* of Holmes) and is transmitted by the aster leafhopper, *Macrostelus divisus*, Uhl., which does not breed on potato. It occurs most frequently in the north and east of the United States, and has been prevalent since 1931 in West Virginia, where it reduces the yield of the plants by up to 50 per cent. and impairs the quality of the tubers, but it appears to be of little importance in the southern and far western States. Its symptoms are described in detail, and ways in which it differs from other diseases with which it is sometimes confused are discussed. Tests showed that plants that do not exhibit symptoms until late in the season yield more than those affected early.

The virus has been transmitted experimentally by *M. divisus* to potato from aster and from certain weeds growing near potato fields to potato, but not to potato or aster from potato.

*Thamnotettix nigrifrons*, Forbes, which was occasionally taken on potato plants, failed to transmit it between asters and potatoes. Attempts to transmit it by grafts were unsuccessful, in spite of the positive results of Younkin [31 275], and tests indicated that it is not transmitted through the tubers.

The flight of *M. divisus* in potato fields was studied in 1939-43 by means of a light-trap [cf. 31 275]. The results showed a fairly close relation between the number of leafhoppers caught and the minimum daily temperature. Few were caught on nights when the temperature fell below 60°F., and most during a succession of warm nights when the temperature remained above this figure. In most years, the larger flights were recorded at midsummer or later, but there were always some large flights during May and early June, and it is thought that infection is transmitted to potatoes chiefly by the leafhoppers of the early flights, which probably become infective through feeding on diseased perennial weeds or have overwintered as viruliferous adults. Observations on the spread of the disease in potato fields indicated a tendency for the infected plants to occur in clusters, and it is thought that each cluster was probably infected by a single viruliferous leafhopper.

The disease is difficult to control since it does not depend on the presence of large numbers of the vector, and spraying with Bordeaux mixture, which affords some control of *Empoasca fabae*, Harr., has little effect on *M. divisus*. In experiments in which various treatments were applied to potato, sprays of 12 oz. DDT per 100 U.S. gals. gave good control of *Empoasca* but none of *M. divisus*, though the results were not very conclusive. In a further test, eight weekly applications of a dust of 5 per cent. DDT in pyrophyllite gave significant control of both *E. fabae* and *M. divisus*, as compared with a dust of copper sulphate and lime (20 : 80), and on 13th August, there were six diseased plants in the part of the plot dusted with DDT and 39 in the part treated with the copper-lime dust.

BERGER (B. G.). **How to recognize and control Termites in Illinois.**—*Circ. Ill. nat. Hist. Surv.* no. 41, [3+]44 pp., 1 pl., 32 figs. Urbana, Ill., 1947.

This circular on the control of termites that attack timbers in buildings in Illinois includes general information on their appearance and habits and the damage due to them, and the characters distinguishing termites from other insects with which they might be confused. Most of the damage in Illinois is caused by *Reticulitermes flavipes*, Koll., but three other species of the same genus occur in isolated wooded areas. Structural methods that prevent infestation and common building features that render buildings susceptible to attack are described, and detailed instructions given for the application of poisons to the soil round foundations and to the spaces in foundation walls and beneath basement floors of infested buildings. The materials for soil

treatment are a solution of 10 lb. sodium arsenite in 11 U.S. gals. water applied at a rate of 1 U.S. gal. per cu. ft. soil, and a mixture of trichlorbenzene in fuel oil, kerosene or used crank-case oil (1 : 4), a solution of 2½ lb. pentachlorophenol in 1 U.S. gal. pine oil or 2 U.S. gals. of an alkyl naphthalene diluted with fuel oil to make 7 U.S. gals., and a solution of 1 lb. pentachlorophenol in 2½ gals. trichlorbenzene made up to 30 U.S. gals. with fuel oil, all applied at a rate of 1 U.S. gal. per 2 cu. ft. soil. The mixture of trichlorbenzene and pentachlorophenol [cf. *R.A.E.*, A 33 69] is believed to be more effective than either material alone. Trichlorbenzene is not suitable for use in spaces in foundation walls, since it has an objectionable odour that may persist for a year, but it can be used under concrete basement floors. Sodium arsenite and pentachlorophenol are both commonly used in these situations. The amount to be applied varies, but is usually about a quarter of that used as an outside soil poison. Creosote is stated to be effective when properly applied to wood, but to be rarely of value for longer than a year when used as a soil poison.

**Preventing Damage to Buildings by Subterranean Termites and their Control.—**

*Fmrs' Bull. U.S. Dep. Agric.* no. 1911 (revd.), [2+]37 pp., 31 figs. Washington, D.C., 1946.

The information here given on the prevention of damage to timber in buildings by subterranean termites is almost identical with that in the earlier bulletin [*R.A.E.*, A 31 317], but the section relating to soil poisons has been brought up-to-date. The rates of application recommended for all the previous soil treatments [31 318] are doubled, and trichlorbenzene is now included. It is used in the same manner and at the same rates as orthodichlorbenzene.

**BRETT (C. H.). Interrelated Effects of Food, Temperature, and Humidity on the Development of the Lesser Migratory Grasshopper, *Melanoplus mexicanus mexicanus* (Saussure) (Orthoptera).—*Tech. Bull. Okla. agric. Exp. Sta.* no. T-26, 50 pp., 18 figs., 41 refs. Stillwater, Okla., 1947.**

The rearing experiments described in this paper were carried out in Kansas and Oklahoma in 1940–45 in view of the differences in form, size, colour and markings that have been observed in *Melanoplus mexicanus mexicanus*, Sauss., and uncertainty as to the status of the large form (Rocky Mountain locust) that was described by Walsh as *Caloptenus spretus* and has been regarded as the gregarious phase of *M. mexicanus* [cf. *R.A.E.*, A 21 472–473]. The history of outbreaks of this Acridid in the United States since the early 19th century and Faure's work [*loc. cit.*] indicating that it conforms to the phase theory of Uvarov are reviewed, and published data on the body measurements are compared. The work indicated that *spretus* is not itself the gregarious phase but a large form, for which the author uses the term phase, produced under favourable rearing conditions.

The following is based on the author's summary. The grasshoppers were reared on lettuce, lucerne or maize at 75–116°F. and 20–65 per cent. relative humidity. A few were reared on sorghum, but this food did not promote vigorous development. When the grasshoppers became adult, they were weighed and measurements were made of the tegmen, posterior femur, pronotum and head. Among individuals reared on lettuce and maize, body size increased with temperature up to 100°F. and then decreased. The increase was smallest for head width and greatest for length of tegmen and posterior femur. Grasshoppers reared on lettuce were larger than those reared on maize. The influence of temperature was conditioned by extremes of humidity, which had a retarding effect. The largest adults were those reared on lettuce at 100°F. and 35 or 50 per cent. relative humidity. The tegmina of several of these were at least

24 mm. long, and those of all the individuals reared under these conditions and at 105°F. were within a measurement range that could be ascribed to phase *spretus*. These experiments and field observations both indicate that as conditions become more favourable for development, there is some increase in body size and a considerable increase in wing length. Phase *spretus* exemplifies the maximum of physical development and has occurred in specimens collected from flight under outbreak conditions; it apparently reached its greatest frequency in 1870-80, when it was extremely injurious.

Grasshoppers reared on lucerne never reached the dimensions of phase *spretus*, and many of them were affected by bacterial disease. When they were subjected to cool, humid conditions, the wings were often undeveloped. The tegmina of many individuals were only 6 mm. long. Effects of temperature and humidity on body development were less pronounced than among examples reared on maize or lettuce, indicating that lucerne acted as a limiting factor. Individuals with red tibiae, which are characteristic of phase *spretus*, predominated over those with glaucous or pale tibiae among grasshoppers reared on maize or lettuce, but not among those reared on lucerne. The frequency of red coloration was further increased by high temperatures and humidity. The succulence of the food provided was important for development. None of 200 hoppers placed on dry leaves of lettuce or lucerne at high or low humidities and favourable temperatures survived for more than a few days. Wilted leaves were noticeably less palatable than fresh ones and were less favourable to development. Of the hoppers reared on lettuce, 52 per cent. reached the adult stage at 116°F. and 50 per cent. relative humidity, and a few survived exposure to 125°F. and 50 per cent. humidity for four days. At the highest temperatures, all the individuals twitched nervously and were continuously active, indicating that heat may stimulate swarms to take to flight. At lower temperatures, they remained motionless for long periods.

Hoppers reared under crowded conditions on lettuce at 100°F. and 50 per cent. relative humidity developed the melanic pattern typical of gregarious phases; solitary hoppers did not. The pattern also appeared on hoppers kept at 116°F., probably as a result of continual activity. Adults that had developed under crowded conditions showed no colours or patterns that would distinguish them from those reared under solitary conditions, but were slightly smaller and shorter winged. The factors responsible for the development of large, long-winged adults (phase *spretus*) are not the same as those that produce the colour pattern of the gregarious phase, but the conditions in nature that produce the one probably also result in the other.

The data obtained suggest that phase *spretus* would appear under favourable climatic conditions where the proper type of food was available. Lucerne is attractive to the grasshopper but not conducive to development, so that its cultivation on a large scale discourages the appearance of phase *spretus* and also of phase *gregaria* and may have been responsible for the disappearance of the former.

BUCHANAN (L. L.). **A Correction and two new Races in *Graphognathus* (White-fringed Beetles) (Coleoptera: Curculionidae).**—*J. Wash. Acad. Sci.* **37** no. 1 pp. 19-22, 4 pls. Menasha, Wis., 1947.

The author raises the subgenus *Graphognathus* of *Pantomorus* [R.A.E., A **28** 188] to generic rank and concludes that it is represented in the United States by *G. peregrinus*, Buch. [**28** 189], recorded from southern Mississippi and southern Alabama, *G. minor*, Buch., from Florida, and five races of *G. leucoloma*, Boh., of which three were described as species and two are new. They are *pilosus*, Buch., which is restricted to three counties of Alabama, *striatus*, Buch., which occurs in many parts of south-eastern Louisiana, southern

Mississippi, southern Alabama and Georgia, in South Carolina and possibly in Florida, *dubius*, Buch., which occurs in southern Mississippi, southern Alabama, north-western Florida and North Carolina, *imitator*, n., which is the form that was discovered in North Carolina in 1942 [31 257], and *fecundus*, n., which occurs in southern Mississippi, southern Alabama and north-western Florida, was found in Louisiana in 1939-41, but not since, and is the race to which previous records of *G. leucoloma* in the United States [28 189, etc.] refer. The typical form of the species, of which the author has examined the Argentine type, has not been found in the United States. A key is given to all these species and races, including *G. leucoloma leucoloma*, and the two new ones are described. With regard to their distribution in South America, a single old specimen of *striatus* from Argentina agrees with certain small specimens of this race from the United States, and a specimen believed to be *fecundus* was collected in Uruguay; races *dubius*, *pilosus* and *imitator* have not been found in available South American collections. The races of *G. leucoloma* are closely related but isolated from one another by parthenogenesis, and many similar ones, as yet undescribed, have been found in South America. *G. peregrinus* has been collected in Argentina and *G. minor* in Uruguay.

WATERSTON (J. M.). **Report of the Plant Pathologist (Bermuda) for the Year 1946.**—18 pp., 6 figs. Hamilton, Dep. Agric., 1947.

Entomological investigations in Bermuda in 1946 again dealt largely with pests of the Bermuda cedar (*Juniperus bermudiana*) [cf. R.A.E., A 36 48]. The Coccids, *Lepidosaphes newsteadi*, Šulc, and *Carulaspis (Diaspis) visci*, Schr., spread rapidly and proved capable of killing the trees within two years from the first sign of attack. The areas of infestation, which do not yet overlap, are shown on maps. *L. newsteadi* occurred over the whole eastern section; crawlers were observed in the field during July–November, and males in one locality in October. Infestation by *C. visci* was most severe in the Paget district, to the north of Hamilton, and the peak of the damage was reached in August, when many of the infested trees appeared greyish-white. Little spread was noticed after October. Observations indicated that *C. visci* has several overlapping generations a year. Crawlers were observed in August–November and adult males in February, August and November. The crawlers appear to be spread mainly by wind. No trees have been found attacked by both Coccids simultaneously, but infestation by one or other of them and *Acutaspis perseae*, Comst. (erroneously identified in previous reports as *A. (Chrysomphalus) agavis*, Tns. & Ckll. [36 49, etc.]) is common.

All three Coccids were parasitised by *Aspidiotiphagus lounsburyi*, Berl. & Paoli, an Aphelinid that was erroneously recorded in the previous report as *A. citrinus*, Craw [36 49], which, however, also occurs in Bermuda, an earlier identification from *Acutaspis perseae* [22 305] having proved correct. Very few of *L. newsteadi* appeared to be parasitised, however, and then only when exposed on the surface of the berries or in close association with *A. perseae*, which was the preferred host. An attempt was made in June–July to secure further biological control of *L. newsteadi* by introducing *Hemisarcophaga malus*, Shimer; this mite is known in Europe and North America as an efficient predator of *L. ulmi*, L. [cf. 33 357], a Coccid that does not occur in Bermuda. Examples of *H. malus* that were sent without any hosts from Canada in May arrived in poor condition, but it was subsequently found that the mite would oviposit on pieces of branches or leaves of orange infested by *L. beckii*, Newm., from Bermuda. It was therefore introduced in such infested material, and 435 adults and immature stages were received and liberated. Some control of *L. newsteadi* was obtained by spraying with 2 per cent. oil emulsion (1.7 per cent. actual oil) in February, but the trees were injured when the applications were made after April. It is thought that spraying with oil in winter and with

lime-sulphur in summer would give better results. *Aspidiotiphagus lounsburyi* attacked *C. visci* in every month, but was most numerous during June–August, and its incidence was not apparently affected by oil sprays or heavy rain. Although parasitism reached 90 per cent. in many instances, it did not appear to check the increase of *C. visci*, and the introduction of further parasites may be necessary. Sprays of lime-sulphur, 2 per cent. oil emulsion alone, or 1 per cent. oil emulsion with nicotine sulphate (1 : 800) did not reduce injury to the trees when applied after March; the spray containing nicotine sulphate gave high mortality of the Coccid, but was expensive.

In an experiment in which sprays were applied in March, April and May against the mite, *Paratetranychus ununguis*, Jac., which caused premature defoliation of *J. bermudiana* in May, the best control was given by wettable sulphur (8 lb. per 100 gals. water), which also caused the least injury to the foliage. A great increase in infestation was observed in plots sprayed with Gesarol AK 50 (50 per cent. DDT) at 2 lb. per 100 gals. Oil emulsion (1·7 per cent. actual oil) gave some control, but injured the foliage.

Other pests observed on *J. bermudiana* included *Cinara juniperi*, Deg. [cf. **33** 289], which feeds on the bark of the twigs, causing browning and dieback, but not on the foliage; *Contarinia juniperina*, Felt, of which larvae were found in twigs in two localities in March and November; and *Thamnonoma ochrifascia*, Warren, eggs and larvae of which were collected as early as February [cf. **34** 190]. Nymphs of *Ormenis infuscata*, Stål, were seen on various plants in February, and adults became numerous in March. Eggs of this Flatid were found, for the first time, beneath a dense waxy covering on the inner side of dead leaves clothing the base of healthy shoots of *J. bermudiana* and their presence indicates that *Ormenis* can complete its life-cycle on the aerial portions of that tree [cf. **34** 190].

*Gnorimoschema operculella*, Zell., was scarce in the field until late April, and potatoes harvested in the second half of April were uninjured by it. In an attempt to introduce its parasite, *Copidosoma koehleri*, Blanch., 38,570 parasitised larvae were despatched by air, without food, from California, and arrived in excellent condition, and about 771,400 parasites were liberated in ten localities between 18th March and 29th April. No recoveries have been made of this polyembryonic Encyrtid or of *Bracon* (*Microbracon*) *gelechiae*, Ashm., or *Chelonus phthorimaeae*, Gah., which were introduced in 1945 [cf. **36** 49].

A spray of DDT (Gesarol AK 50) proved ineffective against *Aphis gossypii*, Glov., on Easter lilies (*Lilium longiflorum* var. *eximium*) during January–February, and was less effective against *Heliothis armigera*, Hb., on maize than Gesarol A 3 dust (3 per cent. DDT), which gave excellent control when applied in April to the silks as soon as they developed. *Ceratitis capitata*, Wied., attacked avocado and green fruits of *Casimiroa edulis*, and also certain varieties of *Citrus*, of which it is not an important pest. Other pests of *Citrus* were *Phyllocoptruta* (*Eriophyes*) *oleivorus*, Ashm., infestation by which has been greatly reduced as a result of the increased use of sulphur sprays but was common in August on neglected lemon trees, *A. gossypii*, which was effectively controlled by regular sprays of nicotine sulphate, and *Lepidosaphes beckii*, which was parasitised by *Aspidiotiphagus lounsburyi* in June. *Macrosiphum solanifolii*, Ashm., attacked tomato but was controlled by nicotine dust; *Halticus bracteatus*, Say (*citri*, Ashm.) injured peach foliage in July; and *Feltia subterranea*, F., attacked stored potato tubers in May. Rotting tubers that had been harvested in May and stored in the open field were found in October to be infested by *Gnorimoschema operculella* and *Pseudococcus citri*, Risso; *Scatopse fuscipes*, Mg., and *Leptomastix* sp. were also found on them, and the mealybug may have been the host of the latter. In the early autumn, which was wet, an outbreak of *Laphygma* (*Xylomiges*) *eridania*, Cram., caused considerable damage to string-beans, potatoes and sweet potatoes.

Insects intercepted in quarantine comprised nine living adults of *Popillia japonica*, Newm., in five aircraft from New York and Baltimore and a ship from New York; *Aspidiotus destructor*, Sign., on sprouted coconuts from St. Lucia; *Chrysomphalus ficus*, Ashm. (*aonidum*, auct.) on grapefruit from Florida; a pupa of *Contarinia* sp., a larva of *Phlyctaenia rubigalis*, Gn., and examples of *Myzus persicae*, Sulz., on flowers of chrysanthemum brought by air from the United States; and the predacious Coccinellid, *Hippodamia tredecimpunctata* subsp. *tibialis*, Say, on vegetables from the United States.

PRYOR (M. G. M.), RUSSELL (P. B.) & TODD (A. R.). **Protocatechuic Acid, the Substance responsible for the Hardening of the Cockroach Ootheca.**—*Biochem. J.* **40** no. 5-6 pp. 627-628, 5 refs. Cambridge, 1946.

From the similarity between the ootheca of *Blatta orientalis*, L., and the hard brown exocuticle of insects, it was inferred that the phenolic substance responsible for the hardening of the former is also responsible for the hardening of the latter [*cf. R.A.E.*, A **35** 202]. An account is given of experiments in which this substance was isolated from the ootheca of *B. orientalis* and identified as protocatechuic acid (3 : 4-dihydroxybenzoic acid) [*cf. 35* 203].

ALLMAN (S. L.). **Skin Blemish of Nectarines caused by Plague Thrips.**—*Agric. Gaz. N.S.W.* **59** pt. 8 pp. 423-426, 3 figs. Sydney, 1948.

It is stated in this more detailed account of an experiment on the control of thrips causing skin blemishes on nectarines in New South Wales [*cf. R.A.E.*, A **36** 306] that the species concerned was *Thrips imaginis*, Bagn., that the 0.1 per cent. DDT spray used was in the form of an emulsified solution in solvent naphtha, and that final examination of the nectarines at harvest showed that 5 per cent. of the fruits from sprayed trees had minor blemishes, while 63 per cent. of those from unsprayed trees had blemishes most of which would lower their grade or render them unsaleable.

WALLACE (C. R.). **A new Poison Bait for Black Beetle.**—*Agric. Gaz. N.S.W.* **59** pt. 8 p. 435. Sydney, 1948.

In the course of investigations on the Dynastid, *Heteronychus sanctaehelenae*, Blanch., in New South Wales in 1947-48, a bait of broken maize poisoned with 3 lb. per cwt. of a dust containing 1.3 per cent.  $\gamma$  benzene hexachloride proved highly effective against the adults when scattered over cultivated land during the warmer months of the year. In one instance, it killed 438 beetles in 14 yards of furrow, and it was so attractive that many beetles preferred it even to young maize plants. To prepare it, maize that has been broken mechanically so that each grain is reduced to 6-8 fragments is spread over a large sheet of paper and evenly sprinkled with the dust, and the dusted maize is then poured into a drum and thoroughly mixed.

Infested cultivated land should be baited as soon as the beetles become active in spring, before the crop is planted, a rate of  $\frac{1}{2}$  bushel per acre being suggested. Even better results might be obtained by harrowing or disking the bait into the soil and then scattering more on the surface. Migrations of beetles crawling from adjacent grassland can be prevented by a vertical-sided furrow, and if the furrow is likely to flood or crumble, bait should be scattered along it. If the bait is not applied until after the crop has been planted, it does not prevent all loss and serves chiefly as a substitute for jetting with DDT [*cf. R.A.E.*, A **35** 218, 372]. The most effective periods for using the bait are in spring or early summer against the overwintered adults and early in the year

to kill the newly-emerged ones, which appear in January in northern coastal areas and in February further south.

ALLMAN (S. L.) & FRIEND (A. H.). **New Insecticides and Fruit Fly Control.**—*Agric. Gaz. N.S.W.* **59** pt. 10 pp. 531–533, 2 figs. Sydney, 1948.

An account is given of an experiment carried out on plum in New South Wales to compare the value of cover sprays of DDT, BHC (benzene hexachloride) and chlordane with that of bait-sprays of tartar emetic for the control of *Dacus (Strumeta) ferrugineus tryoni*, Frogg. The first three insecticides were used at 0·2 per cent. in the form of emulsified solutions and applied at fortnightly intervals at the rate of about 1 gal. spray per tree. The DDT sprays were prepared from two proprietary emulsion concentrates, while the BHC (13 per cent.  $\gamma$  isomer) and chlordane were dissolved in xylene to which an emulsifier was added; 1 lb. white sugar per 10 gals. spray was included with all three materials to encourage feeding by the flies. The bait-spray consisted of 2 oz. tartar emetic and 2½ lb. sugar in 4 gals. water, and was splashed on to the foliage at the rate of nearly 9 fl. oz. per tree. The first treatments were made on 3rd December, 1947, when the fruits were still green, and three cover sprays and 11 bait-sprays were applied to the respective plots in the course of six weeks. As a result of unusually heavy rainfall and low mean temperatures, fruit-fly activity was relatively slight during the test period.

The plums were picked between 7th and 16th January 1948 and examined. The results, which are tabulated, showed that the percentages of undamaged fruits from all the treated trees in the various blocks were 93·8 for tartar emetic, 92·3 and 85·9 for the two DDT sprays, 69·7 for BHC and 56·1 for chlordane. The treatments were not replicated, but the differences in the results were enough to indicate that the tartar emetic and DDT both gave an appreciable degree of control, and a survey showed that fruits in surrounding home gardens were heavily infested, the average loss being estimated at about 75 per cent. Some marking of the skins of the plums was noticed where the various cover sprays were applied, but this may have been due to the sugar. The cost of the materials for the bait-sprays was only about half that of the cover sprays, and their use saved time and labour. Although rain fell on 21 of the 42 days of the test period, the bait-spray could still be readily observed on the trees.

**Insect Pests.**—*Agric. Gaz. N.S.W.* **59** pt. 8 pp. 419–422, 426, 2 figs., 1 ref. Sydney, 1948. *T.c.* pt. 9 pp. 475–479, 492, 7 figs. *T.c.* pt. 10 pp. 537–541, 546, 4 figs.

The papers noticed below are from three parts of a series on insect pests in New South Wales; unlike previous ones [*cf. R.A.E., A 37 23, etc.*], they include some papers by specified authors.

HELY (P. C.). **Bean Fly Control**, pp. 419–420, 1 fig., 1 ref. A further experiment with DDT for the control of *Agromyza phaseoli*, Coq., on beans [*cf. 36 46*], was carried out in February–March 1947, when a 2 per cent. DDT dust and sprays containing 0·05 or 0·1 per cent. DDT as an emulsified solution or 0·05 per cent. DDT as a dispersible powder were compared with the standard spray of nicotine sulphate in white-oil emulsion [*loc.cit.*]. All the treatments were applied twice weekly except 0·1 per cent. DDT which was applied weekly, and weekly applications of the 0·05 per cent. emulsified solution were also included. The experimental plots, which had all been lightly sprayed with 0·075 per cent. DDT on 27th February, received four or seven applications between 28th February and 26th March, just before blossoming. At the time the experiment was begun, self-sown beans were heavily attacked, and plants

six inches high on adjacent land were beginning to collapse owing to infestation of the stems. Picking began on 13th April, and the mean yields (in lb. per plot) were 74.25 for the 0.05 per cent. DDT in emulsified solution, being identical whether it was applied once or twice weekly, 66.25 for the 2 per cent. DDT dust, 67.5 for the 0.1 per cent. DDT in emulsified solution, 65.5 for the 0.05 per cent. suspension, and 53 for the nicotine-sulphate spray. The differences between these yields were not statistically significant, but the DDT sprays appeared to give the best control. The stems of plants that received them were free or almost free from larvae at flowering time, whereas infestation of the others was light to moderate. There was no appreciable infestation by *Tetranychus telarius*, L. (*urticae*, Koch) in any of the plots.

It is recommended that beans planted in summer and autumn in districts susceptible to infestation by *A. phaseoli* should be sprayed at weekly intervals with 0.05 per cent. DDT in emulsified solution, from the third day after the plants appear above ground until just before blossoming. Lime-sulphur at 1 : 100 can be included in the sprays against *Tetranychus*, or, if sulphur dusts are preferred for the control of the mite, one containing DDT, sulphur and kaolin (2 : 50 : 48) would also be of some value against *A. phaseoli*.

MORGAN (W. L.). **Control of Tomato Pests**, pp. 421-422, 1 fig. Apart from cutworms, against which baits containing Paris green are still recommended, insect pests of tomatoes, including fruit caterpillars [*Heliothis armigera*, Hb.], stem caterpillars [*Gnorimoschema plaesiosema*, Turner], green aphids [*Macrosiphum solanifolii*, Ashm.], Jassids, the green vegetable bug [*Nezara viridula*, L.], the vegetable weevil [*Listroderes obliquus*, Gylh.] and the black beetle [*Heteronychus sanctae-helenae*, Blanch.], are best controlled with DDT. For spraying, emulsified solutions are preferred to dispersible powders, because of their somewhat better contact action; 0.05 per cent. DDT is suitable for a routine spray, but 0.1 per cent. is recommended against *N. viridula* and *L. obliquus* and for jetting into the soil at the base of the plants against *H. sanctae-helenae*. DDT dusts are generally applied to tomatoes at 1 per cent. strength. For the control of the tomato mite [*Phyllocoptes lycopersici*, Masee], sulphur or lime-sulphur can be included in the emulsified sprays; a spray generally used in coastal areas for combined control of pests and fungus disease consists of 16 fl. oz. 20 per. cent. DDT emulsion concentrate, 1 lb. colloidal sulphur and 40 gals. Bordeaux mixture (1 : 1 : 40 or 1 : 1 : 20), and a dust mixture commonly used for the same purpose contains 40 per cent. sulphur, 8 per cent. copper oxychloride or copper carbonate and 1 per cent. DDT. In most areas, tomatoes should be sprayed or dusted against *Phyllocoptes* every three weeks, and seed-beds should be treated about ten days before transplanting. For the control of *H. armigera*, sprays or dusts of DDT should be applied at intervals of 7-10 days during the fruit-setting period to spring and autumn crops in coastal areas and at fortnightly intervals to mid-season crops and those grown inland. To control *G. plaesiosema*, which occurs in some areas near Sydney and Newcastle, seed-beds should be treated every 7-10 days, and treatment should be continued for two months after planting out.

ZECK (E. H.). **The Pine Aphid** (*Cinara thujafolia*), pp. 422, 426. *Cinara thujafolia*, Theo., which infests various conifers of the genera *Thuja*, *Callitris* and *Cupressus*, became unusually numerous in 1947-48. It is most abundant in the cooler months, and its feeding causes yellowing of foliage and wilting of the ends of branchlets; infested trees become blackened by sooty mould developing on its honeydew. Sprays of 1 fl. oz. nicotine sulphate and 8 fl. oz. white-oil emulsion in 4 gals. water or of 3 fl. oz. 20 per cent. DDT emulsion concentrate in 4 gals. water, repeated, if necessary, after about a week, are recommended for control.

**Citrus Aphids** (*Toxoptera aurantii* and *Aphis* sp.), pp. 475-476, 1 fig. Very brief notes are given on the bionomics of *Toxoptera aurantii*, Boy., and *Aphis* sp.

on *Citrus*, which they injure from mid-September to mid-October in coastal areas. They can be controlled by sprays of nicotine sulphate, 0.05 per cent. DDT or HETP ("hexaethyl" tetraphosphate). The last is effective at 1 : 1,600 (1 fl. oz. in 10 gals.) and should be used alone or with neutral spreaders; it is incompatible with spray materials containing lime or with white-oil emulsion.

MORGAN (W. L.). **The Heliothis Caterpillar** (*Heliothis armigera*), pp. 477-479, 492, 6 figs. Larvae of *H. armigera*, the bionomics of which are briefly described, attack a wide range of cultivated plants, but can be controlled on all of them with sprays and dusts of DDT. Since they pupate in the soil and moisture favours the rapid emergence of the adults, control treatments should in many instances be applied to crops within 10-14 days of rainfall heavy enough to wet the soil to a depth of 3-4 inches. A 0.1 per cent. DDT spray or a 2 per cent. DDT dust, the former either as an emulsified solution or as a suspension prepared from a dispersible powder, can be applied to most flowers and vegetables. On tobacco, a 0.1 per cent. spray or a 1 per cent. dust should be applied at intervals of 2-4 weeks, particularly to the growing tip and top growth. Stone and pome fruits should be sprayed with 0.05 per cent. DDT. Lucerne seed crops and flax should be dusted with 5 per cent. DDT at the rate of 15-20 lb. per acre, applied by means of a power duster or from an aeroplane about a week after the crops are in full flower, or a spray containing about 2 lb. dispersible DDT in 2-6 gals. water can be applied as an aerosol from a machine designed for the application of concentrated insecticides. The larvae can be controlled in maize by treatment of the individual ears with a 5 per cent. DDT powder or a few drops of white mineral oil, which should be applied to the silks about five days after they appear, but this is expensive. Areas cropped with maize should be ploughed or harrowed in winter to destroy the pupae.

**E605—an interesting new Insecticide**, pp. 537-538. Tests carried out overseas have shown that parathion (diethylparanitrophenyl thiophosphate), also known as E605, Thiophos and 3422, is effective against a wide range of insects and mites, but it is reported to be very toxic to man and warm-blooded animals. It is a heavy liquid, insoluble in water, compatible with numerous insecticides and fungicides and, according to some sources, stable in alkaline media. Some small-scale tests with it were made in New South Wales [*cf.* also B 37 20].

P. C. Hely reports that, when tested at a concentration of 1 : 10,000 against a heavy infestation of nymphs and adults of the olive lace bug (*Froggattia olivina*, Horv.), parathion gave excellent kill in 24 hours, although light showers of rain fell a few hours after spraying; numbers of ants (*Iridomyrmex* sp.) were also killed. In a comparative test, HETP gave almost as good results, but the concentration was 1 : 1,600.

A. H. Friend states that heavy infestations of *Myzus persicae*, Sulz., on celery were sprayed with parathion at 1 : 10,000 alone or with Bordeaux mixture (1 : 1 : 40) or lime-sulphur (1 : 100). Some of each liquid was applied immediately after mixing and some after standing for 24 hours. The knockdown and kill of Aphids was of the same order for each of the six treatments, and no incompatibility or breakdown was evident.

WASON (E. J.) & LLOYD (N. C.). **DDT and Codling Moth Control**, pp. 538-540, 2 figs. Experiments carried out over three years on the control of the codling moth [*Cydia pomonella*, L.] on apple have shown that four or five applications of 0.1 per cent. DDT sprays, the first after all the petals have fallen and the remainder at intervals of 2-3 weeks, should reduce the spring brood to harmless proportions and eliminate the need for summer sprays against the second brood. Applications of DDT after mid-December are undesirable if populations of the woolly Aphid [*Eriosoma lanigerum*, Hsm.] and Tetranychid mites are to be kept at a minimum [*cf.* 35 317]. *Aphelinus mali*, Hald., the parasite of *E. lanigerum*, does not become active until after late December, and if the use of DDT is confined to the early part of the season, the surviving parasites can multiply

sufficiently during January and February to ensure effective Aphid control in autumn. Leaving several heavily infested trees unsprayed and saving infested prunings before the application of dormant oil sprays will also assist in maintaining the population of *A. mali*. In districts in which lime-sulphur is much used for the control of black spot [*Tenturia inaequalis*], this largely prevents an increase of Tetranychid mites, but, if necessary, they can be controlled with dispersible or colloidal sulphur at 2 lb. per 100 gals., preferably combined with the final DDT spray in December. In warmer districts, such as the Murrumbidgee Irrigation Area, HETP at 1 : 1,600, with a neutral wetting agent, is recommended in place of sulphur sprays during very hot weather; one application should be made with the last DDT cover spray in December, and, since it is not ovicidal, another 10–12 days later. This spray also controls *E. lanigerum* if applied at high pressure as a coarse, drenching spray. HETP is not compatible with Bordeaux mixture, lime-sulphur, white oil or calcium caseinate, and should not be used for a week after an application of any of these materials.

GELLATLEY (J. G. G.). **New Insecticides on Aphids. Some preliminary Tests**, pp. 540–541. In August 1948, atomised sprays prepared from various new insecticides were tested against *M. persicae* and *Brevicoryne brassicae*, L., which were very numerous on cabbage, and also against the former on celery. The materials compared were a proprietary DDT-nicotine-naphthalene insecticide used at 1 : 800 with or without a neutral spreader (3 oz. Agral L per 100 gals.), HETP at 1 : 2,000 with the same spreader, TEPP (tetraethyl pyrophosphate) at 1 : 2,000, and parathion at 1 : 10,000. Extremely good kill of *M. persicae* on young potted cabbage plants was obtained in 24 hours with parathion, and good kill with TEPP and HETP, but DDT-nicotine-naphthalene, with or without the spreader, was unsatisfactory. All the insecticides proved unsatisfactory against *B. brassicae* on lightly infested plants. The parathion and DDT-nicotine-naphthalene sprays gave poor results when applied to large celery plants heavily infested with *M. persicae*. When the test was repeated with an additional treatment consisting of parathion with Agral L and care was taken to wet the plants thoroughly, using  $\frac{1}{2}$  pint liquid per plant, Aphids were eliminated on plants receiving parathion with or without the spreader and the DDT-nicotine-naphthalene spray with the spreader. Satisfactory results were obtained with the latter without the spreader, but a few living Aphids remained, and the inclusion of Agral L appeared advantageous.

LLOYD (N. C.). **The Use of DDT to control the Cherry Slug (*Caliroa limacina*)**, pp. 541, 546, 2 figs. As emulsified solutions of DDT in solvent naphtha with Wetsit had proved effective against *Myzus cerasi*, F., on cherry, a small trial was carried out to ascertain whether such a spray would also control *Caliroa limacina*, Retz. Two of four adjacent infested trees of an early variety of cherry were sprayed on 15th December with a 0.05 per cent. emulsified solution of DDT, and 24 hours later there were very few living larvae on them. The majority were wriggling freely on the ground beneath the trees and had lost their slimy coating; they were nearly all dead three days after spraying, and only an occasional living larva was subsequently seen on the sprayed trees, whereas populations remained high until late December on the unsprayed ones.

[SKVORTZOV (A. A.). **Скворцов (A. A.). On the Permeability of Insect Integuments for Contact Insecticides.** [In Russian.]—*Advances mod. Biol.* 21 no. 2 pp. 249–256, 30 refs. Moscow, 1946.

The author states from a review of the literature that the cuticle of insects consists of three layers, the epicuticle, which consists of a lipid phase and a protein phase, the exocuticle, which consists mainly of chitin and protein, and sometimes lipoids in the surface layer, and the endocuticle, which contains only

chitin and protein. Owing to the lipoids, the cuticle offers resistance to the penetration of chemicals, including contact insecticides. The author studied the factors concerned in penetration by using a technique similar to that of Il'inskaya [*R.A.E.*, A **35** 277]. The two ends of a third-instar larva of *Musca domestica*, L., were cut off and the rest of the body squeezed with a glass rod to expel the contents. The empty skin was then filled with Infusoria (*Paramecium*) and the two ends tightly sewn up. The Infusoria were visible through the cuticle and died after the whole had been immersed in a suitable toxicant.

Solutions of salts (electrolytes) penetrated more slowly than organic compounds (not electrolytes) that are highly soluble in the lipoids. Thus, a saturated solution of copper sulphate penetrated in 4–4½ hours, while 20 per cent. solutions of acetic, formic and oleic acids required only 20–30 minutes. Ether and chloroform penetrated in 5–10 minutes, dichlorethane in 4–5 and carbon tetrachloride in 2–3, all these compounds being solvents for lipoids. When the lipoids were removed from the cuticle by ether extraction, the copper-sulphate solution penetrated in 4–5 minutes, confirming the view that the lipoids control the rate of penetration. In the author's opinion, some substances (not electrolytes) penetrate through the lipoid phase, which they dissolve, while others (electrolytes) do so through the pores of the protein phase; in this case, penetration is affected by the size of the molecules and by such factors as adsorption. Considerable differences were observed in rate of penetration of the cuticle of comparable larvae, apparently owing to individual peculiarities [*cf.* **31** 69]. A co-efficient of penetration [*cf.* **35** 278] can be obtained by dividing the average time required to obtain mortality of the Infusoria in the extracted skin by that in the untreated one.

NEAL (P. A.), SWEENEY (T. R.), SPICER (S. S.) & VON OETTINGEN (W. F.).

**The Excretion of DDT (2, 2-bis-(p-chlorophenyl)-1, 1, 1-trichloroethane) in Man, together with clinical Observations.**—*Publ. Hlth Rep.* **61** no. 12 pp. 403–409, 4 figs., 7 refs. Washington, D.C., 1946.

Details are given of an experiment in which the ingestion by a normal man of a single dose of 11 mg. per kg. body weight of DDT dissolved in olive oil, corresponding to a total dose of 770 mg., did not cause detectable toxic effects, but part of the DDT ingested was metabolised to di-(p-chlorophenyl)-acetic acid (DDA) and excreted with the urine [*cf.* *R.A.E.*, A **36** 162]. The amount of this metabolite excreted was highest on the second day; it decreased rapidly on the third and fourth days and gradually during the subsequent ten days.

CUNLIFFE (N.) & HODGES (D. J.). **Studies on *Oscinella frit* Linn. Notes on the Resistance of Cereals to Infestation.**—*Ann. appl. Biol.* **33** no. 4 pp. 339–360, 1 fig., 7 refs. London, 1946.

Since the resistance of varieties of oats to attack by *Oscinella frit*, L., seemed to be associated closely with growth, earlier experiments in England [*cf.* *R.A.E.*, A **25** 109], which showed a small but significant difference in percentage crude-fibre content, a marked significant difference in total carbohydrate produced per unit content of nitrogen and a suggestive but insignificant difference in silica content between two varieties showing different degrees of resistance, were repeated on a wider statistical basis. The tests dealt mainly with the resistant varieties Summer and Spet, the susceptible varieties Star and Victory and the crosses Spet × Star (Sandford) and Summer × Star. It was found that resistance to infestation was not correlated with either carbohydrate or silica content (factors that might be expected to affect the larvae). When the numbers of eggs laid on the plants of Summer, the most resistant variety known, were artificially increased, it proved as susceptible

to attack as Victory, and it is concluded that immunity in the field is due to lack of attractiveness to the ovipositing females, though it is possible that direct resistance of considerable variability exists within a variety, and that increased oviposition provides increased numbers of larvae capable of overcoming such direct resistance; however, no evidence of the existence of direct resistance has been obtained. Observations in the field showed that oviposition was three times as great on the susceptible as on the resistant variety, and selections from crosses between susceptible and resistant types, intermediate in resistance, received an intermediate number of eggs, indicating that resistance was inherited. The number of eggs laid and the extent of infestation were also both greater on oats than on wheat or barley. It was shown that the behaviour of the ovipositing flies was influenced to some extent by stereotaxis, but experiments indicated that it was not affected by chemotaxis, hydrotaxis or phototaxis. Comparison of the resistance to infestation in the field of 22 named varieties of oats with that of a standard variety showed that none was so resistant as Summer, but Richland Iowa 411 and Eagle approached Sandford in possessing moderate resistance.

Investigations on grain infestation and sterility showed that there was no marked difference in grain infestation between Victory and Summer, in spite of the difference in stem infestation in spring. There were significant differences between varieties in susceptibility to sterility, and there were indications that susceptibility to sterility may be inherited and that segregation may be transgressive. Late nitrogenous dressings had no effect on the extent of either grain infestation or sterility. In studies similar to those in 1924 [13 364], the recovery capacity of Sandford almost equalled that of Gris de Houdan, a good tillering variety.

Camphor, turpentine and naphthalene applied between the plants did not repel the flies. Cinnamon reduced infestation by 21.3 per cent. and methyl salicylate and kerosene caused smaller significant reductions. Five applications in suitable weather of 5 per cent. DDT dust to late planted oats of the varieties Victory and Summer reduced the percentage loss of primary shoots from 99.1 and 77.8 for no treatment and 98.8 and 71.8 for treatment with kaolin base alone to 74.1 and 30, respectively, and five applications of a 0.1 per cent. DDT spray (which scorched the foliage severely) and of a 30 per cent. DDT dust reduced that of Victory to 33.3 and 32.8; the significant difference was 7.3.

Some observations were made in view of uncertainty as to whether *O. frit* attacks maize in England. It was found that it did and that there were varietal differences in resistance to attack. The rapid growth of the plant sometimes carried the larva away from the growing point, and in this case the damage was confined to the leaf blades, though some of the plants still lost commercial value. Stems have to be opened and examined individually for infestation, for apparently healthy shoots 12 ins. high sometimes contained larvae that had destroyed the growing point, and stunted shoots that had every appearance of being infested were sometimes free from larvae and any internal evidence of boring.

BROADBENT (L.). **A Survey of Potato Aphides in north-west Derbyshire, 1945.**—*Ann. appl. Biol.* **33** no. 4 pp. 360–368, 1 fig., 6 refs. London, 1946.

Areas in northern England at altitudes of over 400 ft., have appeared to be unfavourable for the flight and rapid multiplication of *Myzus persicae*, Sulz., and therefore for the rapid spread of potato virus diseases; and seed potatoes grown in them are eligible for official certification as high-grade after inspection of the growing crops. North-western Derbyshire is one of these areas, and a survey of it, made in the summer of 1945 to obtain some knowledge of the

distribution of potato Aphids, is described [cf. *R.A.E.*, A **36** 195]. Data relating to the spread of virus diseases on crops on which Aphid counts were made are given in an addendum, though no attempt is made to show the suitability of the area for the growth of certified seed potatoes and it is not suggested that the conditions in 1945 were normal.

The area surveyed is described; some observations were made at the end of winter, and 32 fields of potatoes, scattered over the whole area at altitudes of 340–1,360 ft. above sea level and chosen to include as many different conditions as possible, were visited at intervals of 1–3 weeks from the beginning of June to the end of September; the Aphids considered were *M. persicae*, *Macrosiphum (Aulacorthum) solani*, Kalt., *M. solanifolii*, Ashm., and *Aphis rhamni*, Boy. The weather conditions during the early summer migration are described and their probable effect on the behaviour of the Aphids is discussed [cf. **29** 180]. It was obvious from the large numbers of *Myzus persicae* present during the summer that a very inadequate picture of the overwintering of this species had been obtained by the cursory examination of a few fields of crucifers during the early months of the year. These are grown by most Derbyshire farmers for cattle food, but are usually cut and consumed by the end of January. A few were found in the middle of February 1946, but no Aphids were seen on them. However, Aphids were found on cruciferous vegetables in gardens in various parts of the district and on tulips and other plants under glass. The few peach trees present had been sprayed in winter and were free from Aphids in spring, but fundatrices occurred on small ornamental peaches in tubs in one large glasshouse. It seems likely that the sources of infestation are in the numerous gardens and glasshouses of the villages, where small numbers of Aphids can survive all but the most severe winters. The counts showed that the summer of 1945 was very favourable for *M. persicae* on potato in Derbyshire. It was the predominant species in every field studied, and the other species reached large numbers in a few fields only. The size of the population was not affected by the altitude or aspect of a field, but sheltered fields were the least infested. Alates of *M. persicae* began to infest the potatoes during the third week of June and infestation reached a peak in about the third or fourth week of July, whatever the time of planting. Trap records indicated two peaks in numbers on the wing, during the third week of July and the second week in August. At both these times the numbers on the plants fell, probably because a proportion of the population left the potatoes. Some fields had very late peak infestations, in late August or early September, which reached greater proportions than the one in July and were presumably due to a sudden increase in reproductive activity before the autumn dispersal from potatoes. In most cases, the infestation, though falling somewhat after the dispersals of July and August, remained relatively high until late in the season. This would seem to indicate a lack of activity in predators and parasites, but Aphids parasitised by *Aphidius* spp. were numerous, 30–100 per 100 leaves being common, and Coccinellids and Syrphids usually occurred at the rate of 2–10 per 100 leaves. There was no evidence of significantly greater populations of parasites or predators in fields with fewer Aphids. Fungi of the genus *Entomophthora* were prevalent at about the time of the July peak and helped to reduce the Aphids at that time. The ridging of the crop early in the season reduced the numbers of Aphids, and the time taken to build up the population after it indicated that most of the Aphids buried by ridging perished.

*Macrosiphum solani* was recorded in 26 of the 32 fields, though in small numbers, from the second week of June to the third week of September, and was most numerous during July. *M. solanifolii* occurred on all the crops, but in relatively small numbers except in two low-lying fields; it was present throughout the season from the third week of June, reaching a marked peak during the third week of July. *Aphis rhamni* occurred in 26 fields, but reached relatively high

numbers in only one. It was first observed during the last week of June and remained in small numbers in some fields until the end of September. *Rhamnus cathartica*, its winter food-plant, is not recorded as being common in Derbyshire.

The growing of tuber samples taken from six of the fields showed that there had been a gradual but considerable spread of leaf roll [*Corium solani* of Holmes] in 1945, which was correlated with the large numbers of *M. persicae* (over 10 per lower leaf) that persisted from late June to the end of September in all the fields. Further work will be needed to decide whether so large a spread of disease is normal or due to exceptional conditions in 1945.

PARKIN (E. A.) & HEWLETT (P. S.). **The Formation of insecticidal Films on Building Materials. I. Preliminary Experiments with Films of Pyrethrum and D.D.T. in a heavy Oil.**—*Ann. appl. Biol.* **33** no. 4 pp. 381–386, 6 refs. London, 1946.

During the war, when grain and other foodstuffs were stored under abnormal conditions in Britain, films of pyrethrum extract in oil were applied in warehouses against various insects other than those against which they were originally recommended [*R.A.E.*, A **27** 154]. As, however, laboratory experiments had indicated that films sufficiently toxic to kill *Calandra granaria*, L., were not readily formed on surfaces common in buildings, and warehouse observations subsequently confirmed this conclusion, the investigations described in this paper were begun to gain some knowledge of the factors influencing the formation, persistence and toxicity of films, with the ultimate object of improving their persistence and economising in the use of insecticides.

Samples of Fletton-type bricks, rough or planed deal, Portland cement, a mixture of cement and sharp sand (1 : 4) that was comparable with concrete, brick treated with two coats of limewash, fibre and ceiling boards and sacking were sprayed with 1.6 per cent. w/v pyrethrins or 0.8 per cent. w/v crude DDT (74.6 per cent. p,p'isomer) in Shell oil P31 at temperatures of 15–20°C. [59–68°F.] and transferred within 15 minutes to a room kept at 25°C. [77°F.] and 70 per cent. relative humidity, where adults of *Tribolium castaneum*, Hbst., were confined on them for six or nine days. Preliminary experiments with planed deal showed that free insecticide could be seen on the surface immediately after spraying, but not after a few hours, and tests in which the beetles were confined on the wood 0, 2, 6 and 24 hours after the deposition of about 2 mg. pyrethrin solution per sq. cm. showed that the toxicity of the film fell considerably during the first six hours and very little during the next 18. Films on rough deal showed a similar but less pronounced effect, and as these appeared to be the least absorbent substances used, a delay of 24 hours between spraying and exposure to insects was subsequently adopted for all surfaces. Deposits of approximately 0.5–4 mg. pyrethrin solution were more toxic on rough deal and brick than on the mixture of cement and sand, which failed to support a film toxic to *T. castaneum* even at the highest level of deposit. On deal and brick, the toxicity increased with increasing deposit.

In view of these results, deposits of about 4 mg. per sq. cm. were used in subsequent comparisons of surfaces, which showed that the effect of 1.6 per cent. pyrethrin solution was greatest on rough deal and sacking, progressively less on brick and wallboard and least on cement, cement and sand, limewashed brick and ceiling board, whereas that of 0.8 per cent. DDT was greatest on rough deal and limewashed brick, less on brick and least on cement, alone or with sand. Mortality figures are given only for some of the tests with the pyrethrin solution; after six days exposure they were 64–80 per cent. for rough deal and only 18–34 per cent. for brick. Owing to the low toxicity of

the films formed in the laboratory on certain surfaces, a test was carried out under practical conditions in a London warehouse. Areas of wooden floor and limewashed brick wall were sprayed with 1.6 per cent. pyrethrins or 0.5 per cent. crude DDT in oil, applied at a pressure of 65–70 lb. per sq. inch as in general warehouse practice, and adults of *T. castaneum* were confined for three or six days on each treated surface at different times after spraying. The deposits of insecticide on the floor were found to be 0.4–0.6 mg. per sq. cm. The low knockdown and kill generally obtained showed that in practice the persistence of toxic films is likely to be poor, and confirmed the conclusions drawn from the laboratory experiments. Both pyrethrum and DDT were more toxic on wood than on limewash. The greater effect of DDT on limewash in the laboratory may have been due to the higher concentration used or to the fact that the lime coating was much more friable in the laboratory tests, owing to the absence of binding material, and readily covered the insects, thus probably transferring the insecticide more effectively than usual.

Since it appeared that effective films of pyrethrum could not be expected on the materials tested, with the possible exception of wood and sacking, attempts were made to prevent the physical or chemical interaction of the insecticide and substrate by pretreating the surface and thus interposing a thin layer of oil-impermeable material between the two phases. Sections of brick were brushed over with a single coat of 5 per cent. polyvinyl alcohol in water, a proprietary starch paste, a viscous solution of size in water, sodium silicate (waterglass) or 10 per cent. aqueous calcium-chloride solution and allowed to dry thoroughly before being sprayed, or brushed over with a small amount of water or immersed in water for an hour (by which time the water had penetrated 1–1½ ins. into the brick) immediately before spraying. Exposure of adults of *T. castaneum* for six days, beginning 24 hours after spraying, showed that pretreatment with the first four substances increased the toxicity of the insecticidal film, so that it gave 34–100, 90–94, 100 and 100 per cent. mortality, respectively, on them as compared with 2–50 on surfaces not pretreated, whereas water and calcium chloride did not, heavy applications of water apparently reducing it. Starch paste brushed over samples of cement and sand, in order to discover whether one of the successful pretreatments would act on a surface less favourable to film formation than brick, increased the mortality given by the film to 100 per cent. It was evident by visual inspection that polyvinyl alcohol and starch paste slowed down the rate of absorption of the spray, but by the time the insects were put on the films, all free spray had been absorbed, whereas when waterglass and size were used, free insecticide remained on the surfaces until the end of the exposure period (ten days after spraying).

Since the deposits tested in the experiments were 2½–3 times as heavy as those normally applied in practice (1–1.5 mg. per sq. cm.), it is probable that 24 hours or less after application to some of the commoner building surfaces in warehouses, no insecticidal film of sufficient potency to kill relatively resistant insects such as adults of *T. castaneum* will remain. The different toxicities of the films formed on the non-pretreated materials cannot be accounted for without further experimental work, but probably depend on the volume of liquid insecticide transferred from the substrate to the cuticle of the insects and the concentration of active principle in it. Sacking differed from the other materials tested in that droplets of insecticide remained suspended from projecting fibres, but for the others there is no reason to suppose that the volume transferred to the insect was a function of the rate of capillary absorption of the insecticide, since all free insecticide appeared to have left the surfaces before exposure of the insects began, and it was probably derived from the film remaining at the surface after capillary absorption and redistribution had taken place. The great advantages to be gained from the use of some form of pretreatment are evident.

OWEN (R. W.) & WALOFF (N.). **A Note on the Efficiency of a Pyrethrum Spray in controlling *Ephestia clutella* Hb. Moths in a Granary.**—*Ann. appl. Biol.* **33** no. 4 pp. 387–389, 3 refs. London, 1946.

A new method for estimating the numbers of moths and larvae in an infestation of *Ephestia clutella*, Hb., on bulk wheat [R.A.E., A **36** 210–213] was used in 1943 to ascertain the effect of insecticidal treatment on the insect population in wheat and the room in which it was stowed. Sprays of 0·8 per cent. w/v pyrethrins in Shell oil P31 were applied in a London grain store on 5th July and on some date between 12th and 19th August, and weekly estimates were made of the numbers of adults of *E. clutella* present. They had increased from 900 on 15th to 27,400 on 29th June, fell to 600 on 6th July, the day after the first application, but rose to 14,300, 15,100 and 16,500 on 15th, 22nd and 29th July. They had fallen to 9,400 and 3,100 on 5th and 12th August, and were only 13 and 8 on 19th and 26th, after the second spray had been applied. A second experiment was carried out in 1945 in the room in which Richards & Waloff made their population study [*loc. cit.*] and which had received no insecticidal treatment for over two years. It contained about 500 tons of Manitoba wheat, and the total area of exposed surfaces (walls, ceiling, pillars and grain) was about 12,000 sq. ft. Four gallons of a spray of 0·8 per cent pyrethrins in oil was applied on 20th July, and a mean deposit of 1·5 mg. per sq. cm., of which one-sixth was due to the settling mist, was obtained. No moths were seen flying by the time the mist had cleared. Weekly counts of moths showed that the estimated population reached a peak of 173,600 moths on 6th July and was 68,900 on 19th July, the day before spraying, but only one living moth was seen on the day after spraying, and only three more up to 3rd August, when counts were discontinued; it is calculated that about 7,500 moths must have been killed on emergence by the film of insecticide deposited on exposed surfaces. The estimated numbers of *Ephestia* larvae were 22,600 on 13th September and 118,100 on 25th September, and these figures together with observations indicated that there had been no drastic reduction in larvae that could be attributed to the treatment. The periods between maximum moth emergence and maximum larval migration were 72 days in 1943, 64 days in 1944 and 82 days in 1945. Insufficient data have been collected to indicate whether the last figure implies a delay in reaching the peak of larval migration. If this period is longer than normal, it cannot be explained in terms of the physical conditions obtaining in the grain, but may be connected with the application of the spray at the time of moth emergence and oviposition.

AMAN (J.), FARKAS (L.), BEN-SHAMAI (M. H.) & PLAUT (M.). **Experiments on the Use of Ethylene Dibromide as a Fumigant for Grain and Seed.**—*Ann. appl. Biol.* **33** no. 4 pp. 389–395, 5 refs. London, 1946.

The authors describe experiments in which adults of *Calandra oryzae*, L., were exposed to ethylene dibromide in closed vessels. The weevils were introduced 24 hours after the fumigant, to allow time for this to become completely evaporated and distributed, and exposed for 4–24 hours, after which they were observed in a normal atmosphere for at least 48 hours. Insects that appeared normal during the time of exposure often died 48 hours later in a normal atmosphere, and those that appeared dead when removed from ethylene dibromide did not recover even when the time of observation was increased to 10–14 days. The weevils used were selected at random from various parts of Palestine, from various food materials and at different times of year. The results obtained showed that concentrations of 2, 3·8 and 7·1 mg. per litre for exposure periods of 24, 10 and 4 hours, respectively, were sufficient to cause complete kill, the delayed action of ethylene dibromide being evident in all

experiments. Comparison with results obtained with methyl bromide showed that ethylene dibromide is the more toxic and has a more pronounced delayed action. A few tests in which other fumigants and adults of *Tribolium* sp. were also used showed that ethylene dibromide was much more toxic to both insects than carbon bisulphide or ethylene dichloride, but less toxic than methyl bromide to *Tribolium* and less toxic to *Tribolium* than to *Calandra*. No direct experiments were made on the toxicity of ethylene dibromide to other stages of *C. oryzae*, but samples of badly infested grain removed after large-scale fumigations and kept in a warm place for over two months did not become reinfested.

In a section dealing with the toxicity of ethylene dibromide to mammals, it is pointed out that the vapours are toxic and that gas masks should be worn by men exposed to them in a closed space. Rats and guineapigs that ingested an average daily dose of about 40–50 mg. per kg. body weight for about four months did not show any abnormal signs during the period of the experiments. Bread baked from flour that had been fumigated and not aerated contained less than 2 mg. ethylene dibromide per kg., indicating that the daily human consumption would probably not exceed 0.02 mg. per kg. body weight; this should exclude any danger of poisoning by oral administration.

Grain that was kept in an airtight vessel containing the fumigant showed practically no decrease in germinating capacity after nine months in a concentration of 100 gm. per cu. m. A concentration of 200 gm. had no effect during the first months but slightly impaired the germination of wheat and barley after three months. In actual fumigation experiments, ethylene dibromide had no adverse effect on the germinating capacity of wheat, barley, maize, peas or beans. Bread made from flour that had been shaken in tins about two litres in capacity with 0.4 gm. ethylene dibromide and stored for seven days at room temperature, with or without aeration for one hour before preparing the dough, showed no abnormality in volume, taste or odour.

Although ethylene dibromide has a low vapour pressure at room temperature, its high toxicity and high molecular weight make it possible to attain a given degree of toxicity in the atmosphere more rapidly than with other common fumigants. As it is non-inflammable, electrically driven fans can be used to distribute it. Its penetration into stored produce is poor as it is readily adsorbed by grain. In an experiment in which closed vessels about half-filled with wheat (9 per cent. moisture content) and containing fumigant were shaken for 24 hours to produce an even distribution of the fumigant and facilitate its adsorption by the grains, after which insects were introduced and left for 24 hours, concentrations of 15.3 and 22.4 mg. per litre were required for 96 and 100 per cent. kill 48 hours after exposure, and from this test and others it is concluded that ethylene dibromide, methyl bromide and ethylene dichloride are 15–20, 2.5–3 and 8–12 times as toxic in the absence of wheat as in its presence.

The different methods of storing grain in Palestine are described. In silos, ethylene dibromide was effective when introduced at concentrations of 50–100 gm. per cu. m. [5–10 oz. per 100 cu. ft.] by sprinkling it over the surface of the grain during the filling, no insects being found during the subsequent storage period. Fumigation of grain (wheat and barley) in sacks in rooms of various sizes by sprinkling 50–110 gm. per cu. m. on the surface of the sacks and the walls of the rooms gave complete control after exposure periods of 2–6 days, and treatment of bulk grain by introducing the fumigant at 75 gm. per cu. m. at points not more than a metre apart by means of a pipe inserted to various depths was effective after six days. Routine fumigations throughout the country in 1943–45 with ethylene dibromide at concentrations of 50–100 gm. per cu. m. and exposures of 5–10 days gave complete control, even when applied by inexperienced people. Fumigations were carried out only once a year and no reinfestation occurred, probably owing to the protection given by the ethylene dibromide adsorbed by the grain.

BENNETT (S. H.), KEARNS (H. G. H.), MARTIN (Hubert) & WAIN (R. L.).  
**The Use of toxic Polynitro Derivatives in Pest Control. III. The Stability of Dinitro-o-cresol in compounded Products.**—*Ann. appl. Biol.* **33** no. 4 pp. 396–400, 9 refs. London, 1946.

Since dinitro-o-cresol (2,4-dinitro-6-methylphenol), subsequently referred to as DNC, is readily reduced, it was desired to know whether the products of reduction are less or more toxic, whether reduction proceeds in the compounded product during storage and, if so, what precautions are necessary to stop it. The only reduction product that could be isolated from preparations of DNC in petroleum oil was the mono-amino derivative (2-amino-4-nitro-6-methylphenol). It appeared that the effects of further reduction on insecticidal action could be studied by adding alkali to DNC emulsion containing sulphite lye [*cf. R.A.E., A* **32** 308], but it was evident that the effect of variation in pH on the toxicity of the cresol would have to be distinguished from the possible results of reduction. For toxicity comparisons, the aminonitrocresol was prepared by a method described, and this and DNC were dissolved in a mixture of acetone and Carbitol (diethylene glycol monoethyl ether) containing Sulphonated Lorol T.A. (50 per cent. triethanolamine dodecyl sulphate). These solutions were diluted with water to a strength equivalent to 0.225 per cent. DNC immediately before use and a control test was included of the solvents and emulsifiers. Emulsions of DNC and oil were prepared by diluting stock emulsions or by mixing equal volumes of diluted emulsions or solutions containing twice the required amounts of cresol and oil, respectively. The stock emulsions contained 66.7 per cent. oil (shell JD2) and 33.3 per cent. of 10 per cent. sulphite lye prepared from syrup of specific gravity 1.3. When needed, alkali was added to DNC in solution as sodium dinitro-o-cresylate before the addition of the emulsion, and the time between mixing and application was noted; this was never more than 15 minutes. The concentration of DNC, whether as the cresol or its sodium salt, in these cases was usually 0.1 per cent., though it was higher in a few tests.

Eggs of *Operophtera* (*Cheimatobia*) *brumata*, L., laid on cut lengths of well spurred wood, and those of *Psylla mali*, Schm., and *Paratetranychus pilosus*, C. & F. (*Oligonychus ulmi*, auct.) on apple and damson shoots, respectively, that were cut when required, were used for testing. Each treatment was applied to 100–200 eggs of *O. brumata*, 200–300 of *Psylla mali* and 2,000–10,000 of the mite by dipping the twigs into the freshly prepared wash for one second, removing and immediately re-dipping for two seconds to ensure even wetting. After this the twigs were allowed to dry rapidly and subjected to normal weathering until just before the eggs hatched, when they were transferred to tubes in the laboratory. Counts of the total numbers of eggs and the numbers hatching showed that the reduction of one nitro group of DNC suppressed ovicidal properties towards all three species [*cf. also* **33** 198], and indicated that the reduction products are not toxic or could not penetrate into the egg. The toxicity of products of reduction beyond the mono-amino stage was assessed from tests in which DNC was exposed to alkaline reduction. In tests with eggs of *P. mali*, against which petroleum oil had little effect, even at 5 per cent., and the toxicity of DNC was little affected either by dissociation of the cresol or by its distribution between oil and aqueous phases, it was found that the addition of alkali to the emulsion caused a drastic loss of toxicity, which is attributable to alkaline reduction by the reducing sugars present in the spray. Similar tests on eggs of *O. brumata* revealed only the susceptibility of these eggs to petroleum oils, but it was evident from the results obtained with the sodium salt that the ovicidal action of the cresol was little influenced by dissociation. Dinitro-o-cyclohexylphenol at 0.1 per cent. in 2 per cent. petroleum oil, which was tested only against *O. brumata*, inhibited hatching whether it was present as the phenol or salt. The effect of alkaline reduction on toxicity to eggs of the

mite could not be shown because of the low toxicity to them of DNC in alkaline sprays. Direct comparison at a concentration of 0.225 per cent. showed that the cresylate was not ovicidal, whereas the cresol permitted only 6.4 per cent. hatch. Since there was no oil phase present in the latter experiments, it appears that dissociation is the cause of the difference, the ion being non-ovicidal. In tests in which oil was present, toxicity is attributable to the oil itself.

The consistent lack of toxicity of the aminonitrocresol and the loss of ovicidal properties to *P. mali* of DNC under conditions permitting alkaline reduction show that the products of reduction have insignificant ovicidal properties, so that the chemical estimation of the cresol content surviving reduction in compounded products would give a reliable assessment of ovicidal properties. The danger in the use of emulsifiers and other surface-active supplements with reducing properties in DNC preparations is illustrated by the effects of adding alkali to sulphite-lye emulsions in these experiments. A less obvious possibility is electrolytic reduction due to corrosion of the mild steel drums that are the usual containers for emulsions of DNC and oil. To test this, samples of typical emulsions of DNC and oil, one a sulphite-lye emulsion with acid pH, known to be corrosive, and the other a proprietary product with casein-alkali as emulsifier and excess of ammonia added to delay corrosion at the boundary of air, metal and emulsion, were put in bakelite stoppered bottles alone or with strips of polished and unpolished mild steel, tinned steel, galvanised iron and steel coated with a protective synthetic resin, cut from the usual types of container. The cut edges of the strips were coated with a bitumen paint and the bottles were stored in the dark at 25°C. [77°F.] for up to one year. Loss of DNC occurred in all cases in which strips were in the sulphite-lye emulsion, but inspection showed that the bitumen had become detached from the cut edges and the strips coated with tin, zinc or resin showed slight corrosion only at the exposed edge. When polished or unpolished steel was used, the sulphite-lye emulsion deepened in colour, and much dark-coloured insoluble sludge appeared in the separating funnels when it was analysed. The casein-ammonia emulsions retained their colour throughout, no corrosion of the metal strips was seen and no loss of DNC was detected after storage for a year.

YU (T. F.). **A mosaic Disease of Cowpea (*Vigna sinensis* Endl.).**—*Ann. appl. Biol.* **33** no. 4 pp. 450-454, 1 pl., 25 refs. London, 1946.

Cowpeas [*Vigna unguiculata* (*sinensis*)] are attacked in China by a mosaic disease that has been very prevalent along the Yangtze valley and injurious to susceptible varieties, and this paper contains the results of investigations on the symptoms, transmission, host range and properties of the virus carried out in Nanking in 1933-37.

Virus from a mature infected cowpea plant was established in cowpeas of a susceptible variety in the greenhouse by mechanical inoculation, and tests were carried out mainly at temperatures of 25-32°C. [77-89.6°F.]. It was found that the symptoms of the disease might be greatly suppressed when the temperature was below 22°C. [71.6°F.], especially at low light intensities. The characteristic symptoms were conspicuous mosaic patterns, deformation and distortion of leaves and stunting of the plant, but they varied in different varieties and with the type of leaf, time of infection, climatic conditions and individual differences within each variety. The virus was transmitted in the seed and by mechanical inoculation, and by the Aphids, *Aphis fabae*, Scop. (*rumicis*, auct.), *A. gossypii*, Glov., and *Macrosiphum onobrychis*, Boy. (*pisi*, Kalt.) in tests in which they were allowed to feed for 24 hours on an infected plant and then for the same period on healthy ones. The percentages of plants infected by batches of

20 or more individuals of the three species were 60, 100 and 100 in 1935, 70, 80 and 100 in 1936 and 70, 100 and 100 in 1937. The symptoms were identical with those produced by mechanical inoculation and appeared 4-7 days after the transfer of the Aphids. As all three are common in fields of cowpeas, they are assumed to be the natural vectors, and no search was made for others. The virus was transferred to lima bean (*Phaseolus lunatus macrocarpus*) and adzuki bean (*P. angularis*) by mechanical inoculation and by Aphids but in single tests it was not transferred by mechanical inoculation to 31 other plants, which are listed; they included common bean (*P. vulgaris*), broad bean, soy bean and peas, but not asparagus bean [*Vigna unguiculata* var. *sesquipedalis*], which was not available.

The identity of the virus is discussed, and it is concluded that it closely resembles the virus of asparagus-bean mosaic of Snyder [*R.A.E.*, A 30 599] in the symptoms produced and the properties exhibited, and the cowpea mosaic virus of McLean [29 502] in host range and symptoms. Since the symptoms of a virus and its properties *in vitro* are liable to variations because of various factors, such as climatic conditions, differences in reactions of host varieties, time of infection and age of infected plants, it is considered likely that all three viruses are closely related if not identical.

TAYLOR (J. S.). **Notes on the Olive Beetle** (*Argopistes sexvittatus* Bryant).—*J. ent. Soc. sthn Afr.* 8 pp. 49-52, 5 refs. Pretoria, 1945.

Cultivated olive (*Olea europea*) is grown in a few gardens in Graaf-Reinet, Cape Province, and its chief pest there is *Argopistes sexvittatus*, Bryant, the egg, larva and adult of which are described. Other food-plants of this Halticid are the indigenous *O. africana*, which is common, especially in mountainous districts, and is generally heavily infested, and the wild olive of the Mediterranean (*O. europea* var. *oleaster*) of which one example was found at Graaf-Reinet. The eggs are laid in clusters of 2-6 in cavities chewed in the epidermis of the leaf, usually on the lower surface, and the newly-hatched larvae crawl about for a short time and then enter a leaf, generally through the lower surface. They mine in the leaves for a period that is probably not much longer than two weeks, but the duration of the stage could not be determined exactly since attempts to rear larvae from eggs in the laboratory were not successful. Each larva attacks more than one leaf, and living larvae were found in leaves that had become completely dry 4-6 weeks previously. When fully fed, the larvae enter the soil and construct cells at depths of not more than 2½ ins. in which, under laboratory conditions, they pupated nine days later. The combined prepupal and pupal stages lasted 26-27 days in November. There appears to be only one generation a year on cultivated olive, on which the larvae are present only from September to November; they did not appear on *O. europea* var. *oleaster* until late November, and occur later on *O. africana* than on cultivated olive. The adults are present for all or most of the year. They feed mainly on the lower epidermis of the leaf, but cause less damage than the larvae. The only natural enemy observed was a small unidentified Chalcidoid egg parasite, which occurred in negligible numbers. *A. sexvittatus* was not found in the Kat River Valley near Fort Beaufort; *O. africana* there attains a more luxuriant growth, and may be more resistant.

The control measure recommended in the Western Province, where both *A. sexvittatus* and *A. oleae*, Bryant, attack cultivated olive, comprises three or four applications at intervals of 4-6 weeks between harvest and blossoming (about May and September, respectively) of a spray containing 4 lb. lead arsenate and ¼ lb. spreader in 100 gals. water, and this proved effective in Graaf-Reinet.

ULLYETT (G. C.). **Oviposition by *Ephestia kuehniella* Zell.**—*J. ent. Soc. sthn Afr.* **8** pp. 53–59, 1 fig., 2 refs. Pretoria, 1945.

In the course of work on the improvement of methods of rearing *Ephestia kuehniella*, Zell., as a laboratory host for the mass breeding of Hymenopterous parasites, the effect of moth density on oviposition was investigated. Batches of newly emerged females ranging from 3 to 28, with the same number of males, were enclosed in tins with a base area of just over 2.4 sq. ins. in which the base and the middle of the top were replaced by wire gauze. The tins were placed on sifted flour, and the moths oviposited through the gauze. The temperature was 75°F. The numbers of eggs laid on each of the first two days were estimated by weight, and the totals for the two days increased rapidly to 136 as the number of females rose to 19 and then fell off rapidly, with a high correlation in each case. The optimum number of females was thus 7.8 per sq. in., and this result was confirmed in routine work with larger tins. A practical effect of this is that in tests of the attractiveness of different media for oviposition in which the results are evaluated by the number of eggs deposited on each, the greater aggregation of females on the preferred medium induces increased oviposition on it until the optimum density is reached, and its attractiveness is thus exaggerated.

In further tests, french chalk proved as suitable as flour for oviposition. Unlike flour, it is not hygroscopic, and therefore passes easily through a rotary mechanical sieve; its use thus results in a considerable saving of time and labour. It is concluded that the ultimate stimulus for oviposition is the texture of the medium and not its olfactory attractiveness.

BREDO (H. J.). **Note sur les individus de *Nomadacris septemfasciata* (Serv.) vivant isolément.**—*J. ent. Soc. sthn Afr.* **8** pp. 60–70, 3 graphs, 9 refs. Pretoria, 1945.

Observations on the occurrence of isolated individuals of *Nomadacris septemfasciata*, Serv., in phase *gregaria* in the absence of swarms were made over a number of years in the outbreak centres of Mweru-Wantipa and Lake Rukwa, in Northern Rhodesia. In 1943, no locusts in that phase were found in the plains surrounding Mweru-Wantipa until 4th August, when a large swarm appeared to the south-west of the marsh and flew over the plains to the west of it in a northerly direction. Considerable numbers of isolated locusts in phase *gregaria* were then readily obtained over its course and at distances as great as  $12\frac{1}{2}$  miles to either side of the line of flight. Further north, such locusts were also found in two marshes situated more than 21 and 28 miles from the line of flight, where they had not occurred prior to the passage of the swarm.

Isolated locusts in phases *gregaria* and *transiens* had been reported near Lake Albert, Belgian Congo, in 1935 in the absence of swarms [*cf. R.A.E.*, A **25** 10], but they probably originated from swarms reported flying along the foot-hills of Mt. Ruwenzori in Uganda at the time, less than  $12\frac{1}{2}$  miles from Lake Albert. Their numbers increased so much, either by breeding or through the arrival of other isolated individuals, that 30 were collected per man-day in 1936. Their E/F ratio was 2.15, but when caged under natural conditions on the plain, they gave rise to individuals in which it was 1.88. This observation explains why isolated locusts of phases *gregaria*, *transiens* *dissocians*, which resembles *gregaria* in biometrical characters but differs in colour, and *solitaria*, in which the E/F ratio is less than 2, can all be found in places over which swarms have flown. Locusts in phase *solitaria* persist for some years if conditions are favourable, but eventually die out unless other swarms fly over. Areas in which phase *solitaria* has existed for several years in the absence of

swarms should not be regarded as outbreak centres unless the transformation to phase *gregaria* has been observed there. Isolated locusts are found principally in open plains, since those that alight in wooded country tend to move to them.

When the E/F ratios observed among locusts collected in sufficient numbers from a given area are plotted against the percentages showing each ratio, each sex being treated separately, the resulting curves show whether the population is in process of transformation from one phase to another or whether it includes isolated locusts from a passing swarm. Three such curves are given for locusts collected in the plains bordering Mweru-Wantipa in 1939. They indicate that only phase *gregaria* occurred in one of the plains to the north of the swamp, while phases *gregaria*, *transiens congregans* or *dissocians*, and *solitaria* were all present in the other. In the plains to the north of Lake Moero, the population comprised phase *solitaria* with isolated individuals in phase *gregaria*; since phase *transiens* was absent, it was confirmed that the locusts in phase *gregaria* had originated from a swarm that had recently passed.

Theron (P. P. A.). **The artificial Conditioning of Lepidopterous Larvae for Attack by ectoparasitic Ichneumonid Larvae.**—*J. ent. Soc. sthn Afr.* **8** pp. 111–116, 3 refs. Pretoria, 1945.

The following is largely the author's summary. The question of effective utilisation of host material is an important consideration in the rearing of the introduced parasites, *Cryptus sexannulatus*, Grav., and *Ephialtes caudatus*, Ratz., for experiments on the biological control of *Cydia pomonella*, L., in South Africa [cf. *R.A.E.*, A **31** 219]. In the laboratory, females of both species superparasitise some larvae and ignore others so that there is a wastage of parasite eggs and host material. Manipulative methods, such as placing eggs singly on larvae killed in boiling water was satisfactory only in the case of diapausing larvae of *C. pomonella*; newly matured larvae of *C. pomonella* and larvae of *Argyroplote leucotreta*, Meyr., which has proved a good alternative host for both parasites and does not diapause at suitable temperatures, decompose too rapidly. In experiments with larvae of *A. leucotreta*, the addition of dextrin and certain oils, fats, organic acids and inorganic compounds to the boiling water and immersion for one second gave no improvement in the keeping quality of the larvae, which still became dark on the second day after treatment. In tests of treatment by dry heat or immersion at other temperatures, the best was immersion in water at 75°C. [167°F.] for one minute. Further improvement of the technique was necessary, however, as the keeping period of the larvae was only 2–3 days. Of a series of organic and inorganic compounds added to water at 75°C., paraffin wax with a melting point of 40°C. [104°F.] gave the greatest improvement and lengthened the keeping period to four days. This was not long enough for the parasites to complete their development, but they developed normally when transferred from host to host treated in this manner. Larvae killed by electric shock applied by direct contact or when they were suspended in saline solutions began to darken within eight hours. The darkening and liquefaction of the larvae may possibly be due to autolysis and auto-oxidation, to bacterial action or to both.

Rivnay (E.). **Notes on Encyrtidae from Palestine with the Description of a new Species.**—*J. ent. Soc. sthn Afr.* **8** pp. 117–122, 8 figs. Pretoria, 1945.

Records are given of five species of Encyrtids observed in Palestine in the course of work on parasites and the biological control of various pests. They are *Tropidophryne palestinensis*, sp. n., reared from *Eriopeltis* on thistle in July

1941 and from *Pseudococcus citri*, Risso, on pomegranate fruits in September-October 1940 and 1941; *Cheiloneurus latiscapus*, Comp., large numbers of which were obtained, together with *Anagyrus kivuensis*, Comp., its presumed host, and *Leptomastidea abnormis*, Gir., from grapes infested by *P. citri*; *Achrysophagus aegyptiacus*, Merc., which was obtained from *P. citri* on grape and pomegranate, together with *Anagyrus kivuensis*, and was found in the laboratory to parasitise the latter and *Clausenia purpurea*, Ishii; *Homalotylus flaminus*, Dalm., which was reared from the predacious Coccinellids, *Chilocorus bipustulatus*, L., *Hyperaspis guttulata*, Fairm., *Scymnus* sp. and *Exochomus* sp.; and *Homalotylus quaylei*, Timb., of which the male is unknown and which is recorded from *Scymnus includens*, Kirsch, *S. suturalis*, Thnb., *S. quadrimaculatus*, Hbst., and *S. fenestratus*, Sahlb. [cf. R.A.E., A 32 86]. Descriptions are given of both sexes of the new species and *Cheiloneurus latiscapus* and the male of *Achrysophagus aegyptiacus*.

ULLYETT (G. C.). **Distribution of Progeny by *Microbracon hebetor* Say.**—*J. ent. Soc. sthn Afr.* 8 pp. 123–131, 1 fig., 1 ref. Pretoria, 1945.

The way in which *Bracon* (*Microbracon*) *hebetor*, Say, distributes its eggs among available hosts [cf. R.A.E., A 32 88] was investigated further by exposing larvae of *Ephesia kuehniella*, Zell., in numbers varying from two to ten and five to 35 in watch glasses to individual females for periods of 24 hours and the data obtained are discussed with reference to the nature of the search for hosts, the number of eggs deposited on each, the efficiency of the parasite in distributing its progeny, and the control afforded. It was found that the parasites tended to deposit a fixed number of eggs during the 24 hours, regardless of the number of hosts, and to find and paralyse almost all the hosts present before ovipositing in any; females presented with 35 larvae laid significantly fewer eggs than those with fewer hosts, since an excessive amount of time was occupied in searching, but the percentage paralysed did not differ significantly when 35 or 30 host larvae were provided. The females evidently do not conduct an entirely systematic search, since when presented with 20 or 25 host larvae, they paralysed only 84 and 87 per cent., respectively, though it was possible for them to paralyse up to 30 larvae within the limits of 24 hours, but there was no direct evidence of a random search. The number of eggs deposited on a single host varied considerably, but was most frequently 2–3 if enough hosts were available. Up to 4–5 parasites can develop normally on one host, but they become progressively smaller as numbers increase above that limit. When the host larvae are not very abundant, the parasite probably first deposits the optimum number of eggs on each and then oviposits on some again. Although the parasite progeny were not on the whole distributed to the very best advantage, the efficiency of the parent female in this respect increased in proportion to the density of the host population. The natural hosts are mainly Lepidopterous pests of stored products, populations of which are concentrated in a limited space under conditions favourable for increases in density. Once they are established, hosts are readily available, and despite the greater opportunities for the latter to conceal themselves under natural conditions, the parasite is able to exert effective control.

OOSTHUIZEN (M. J.). **The relative Susceptibility of Maize and Wheaten Products to Invasion by the Rust-red Flour Beetle, *Tribolium castaneum* Hbst.**—*J. ent. Soc. sthn Afr.* 8 pp. 137–149, 1 fig., 9 refs. Pretoria, 1945.

In view of divergent opinions as to the relative attractiveness to insects of grain products of different degrees of fineness, eight milling products of maize and eight of wheat were exposed separately in the dark to invasion and oviposition

by *Tribolium castaneum*, Hbst. The eight products were exposed in glass cages and were arranged by the Latin square system in 64 sections each 1 in. square or in 64  $\frac{1}{4}$ -oz. celluloid capsules inserted into holes in a cardboard square, and adults of *T. castaneum* one month old and reared under uniform conditions were introduced into the centre of each cage. Five days later, the distribution of the beetles in the different products was ascertained and the extent of oviposition in each determined by adding yellow unsifted maize meal to the maize products and semolina to the wheat and keeping them at 27°C. [80.6°F.] until all the first-generation adults had emerged. Among the maize products, maize flour and samp were more and hominy chop and bran less attractive to the introduced beetles than mealie rice, or white mixed, or yellow unsifted maize meal, but the differences were significant only in the case of the first two. Of the wheat products, household flour was significantly more attractive than any others; No. 1 unsifted meal was the next most attractive, and, when the materials were exposed in squares but not when they were in capsules, middlings, semolina and sharps were significantly more attractive than pollard or wheat germ. As regards oviposition, hominy chop and maize flours appeared to be the preferred maize products, and bran, samp and mealie rice the least attractive, while household flour and, to a less extent, No. 1 unsifted meal were preferred among the wheat products, bran and wheat germ were the least attractive, and there was no significant difference between the attractiveness of sharps, semolina and middlings. In general, the finer materials were preferred both for invasion and oviposition; samp appears to have been attractive only for concealment.

The rates of development in the different media were tested by rearing ten newly hatched larvae in 5-gm. samples of each product, the moisture content of which had been raised to about 14.5 per cent., at  $30 \pm 1^\circ\text{C}$ . [ $86 \pm 1.8^\circ\text{F}$ .] and 75 per cent. relative humidity, and recording adult emergence; the pupal stage was assumed to be the same in all media. Among larvae reared in maize products, development was most rapid (about 24 days for the two stages) in yellow unsifted meal and No. 1 mixed meal and showed marked retardation in mealie rice and samp (25.9 and 27.5 days); most adults emerged from yellow unsifted meal and No. 1 white meal, and fewest from samp and mealie rice. Among larvae reared in wheat products, development was most rapid (23.1 days) in wheat germ (which contained traces of bran) and slowest (27.5 days) in household flour, and adult emergence reached a maximum in pollard and a minimum in household flour. Yellow maize meal and wheat germ both have a high content of protein (9.64 and 24.96 per cent., respectively) and fat (4.45 and 6.83 per cent.), whereas samp is fairly rich in protein (8.46 per cent.) but poor in fat (0.57 per cent.), and household flour is poor in both protein and fat (11.29 and 1 per cent.). The chemical composition of milling products from different mills varies considerably, and the importance of using standardised materials for experiments of this nature is emphasised.

It is suggested that the apparent lack of infestation by *T. castaneum* in fine milling products under natural conditions is due to the removal of the eggs and small larvae during the final redressing of the flour, the practice of storing it in bags, which hinder the entry of insects, and the relatively short period for which it is stored. The more rapid rate of development in the coarser products tends to give an exaggerated impression of their attractiveness.

MYBURGH (A. C.). **Oil Sprays on Stone Fruits in Summer.**—*J. ent. Soc. sthn Afr.* 8 p. 162. Pretoria, 1945.

Infestation by the codling moth [*Cydia pomonella*, L.] on apricot in western Cape Province can be greatly reduced by two applications of a spray containing a stomach poison [*R.A.E.*, A 35 142], and a similar treatment should also be

effective on plums, prunes and peaches. As the inclusion of an ovicide would probably improve control, preliminary tests were carried out in 1942-43 to determine the tolerance of apricot, plum and peach trees to oil sprays. The oil emulsions were applied at various dilutions to branches or shoots 2-3 ft. long with leaves of uniform length on vigorous trees. The leaves of all, especially those of apricot, were found to be very susceptible to injury, which appeared as translucent spots up to  $\frac{1}{4}$  in. in diameter that sometimes turned brown within a week. When the leaves were retained on the trees for more than three weeks, the discoloured tissues fell away; the more severely damaged leaves turned yellow and fell prematurely. Old leaves were more susceptible than young ones, and the leaves near the base of the shoots often fell within a few days of the application. Seal oil emulsified with casein-ammonia at concentrations well below ovicidal levels and a proprietary emulsion of mineral oil with a viscosity of about 93 Saybolt and an unsulphonatable residue of 83 per cent. at 1 per cent. concentration caused severe injury, and maize and groundnut oils were also injurious at low concentrations. Another proprietary mineral oil of the same viscosity, but with an unsulphonatable residue of 93 per cent., caused only translucent mottling and no shedding, when used at concentrations as high as 3 per cent. A highly refined mineral oil with a viscosity of about 60 seconds Saybolt emulsified with casein-ammonia caused no injury at 3 per cent. and only slight mottling at 4 per cent. Although it appears likely from this work that 2-3 applications of light, highly refined mineral oil at 1 per cent. can safely be made to stone-fruit trees, further investigations are necessary before recommendations can be made.

STUBBINGS (W. A. K.). **Control of Red Spider, *Tetranychus bimaculatus* Harv.**  
—*J. ent. Soc. sthn Afr.* 8 pp. 163-164. Pretoria, 1945.

*Tetranychus bimaculatus*, Harvey, is sometimes very injurious to vegetables, melons and ornamental plants in the western Cape Province during summer, especially in hot, dry weather. As a result of infestation, the leaves become yellow or severely mottled and drop prematurely, the growth of the young shoots is inhibited, and there is a poor set of flowers. In 1937, nicotine and sulphur dusts were applied to heavily infested winter melons on 20th February at a rate of 100 lb. per acre, and counts of mites on the young shoots, including the growing point and first three leaves, were made on 9th March; the weather during the interval was normally bright and warm without rain. The percentages of shoots bearing more than five mites were 88.3 for a proprietary dust containing 4 per cent. nicotine, 70 for no treatment and 3.3 for a proprietary dust containing 90 per cent. sulphur used alone or with an equal weight of the nicotine dust. The effectiveness of the combined dust was probably due entirely to the sulphur in it.

HATTINGH (C. C.). **Argentine Ant versus indigenous Ants.**—*J. ent. Soc. sthn Afr.* 8 p. 164. Pretoria, 1945.

Two species of *Anoplolepis* and one of *Crematogaster* occurred in the western Cape Province prior to the appearance of the Argentine ant [*Iridomyrmex humilis*, Mayr.] in 1901, but no colonies of native ants now exist in areas where the introduced species is abundant, though they are numerous where it is absent. Isolated nests of the native ants occur in places where it is less abundant, and populations are mixed where it has only recently become established. A campaign to exterminate it has been in progress for four years in parts of the Province in connection with the biological control of mealybugs [*Pseudococcus*] on grape vines [*cf. R.A.E.*, A 32 356], and in some vineyards from which it had been eradicated two years previously, the native ants are

reappearing ; this is most noticeable on farms at the foot of mountains, which are probably colonised from higher up the slopes where *I. humilis* is not common.

MYBURGH (A. C.). **Seal Oil Emulsion unsuitable as Summer Ovicide against Codling Moth in Pears.**—*J. ent. Soc. sthn Afr.* **8** pp. 164–165. Pretoria, 1945.

As the supply of emulsions of mineral oil for winter and summer use had become inadequate, seal-oil emulsions were extensively used in dormant sprays in the western Cape Province in 1943, and the possibility of using them instead of summer oils was investigated. Following laboratory tests in which seal oil was about as toxic to eggs of the codling moth [*Cydia pomonella*, L.] as light mineral oil, a field test was made in which pear trees were sprayed three times at weekly intervals beginning on 22nd October with fixed nicotine alone or with 1 per cent. of a mineral-oil or seal-oil emulsion. Trees that received fixed nicotine, alone or with mineral oil, were not scorched, but those that were sprayed with seal oil developed appreciable foliage injury two weeks after the last application. This oil is therefore not recommended as an ovicide for *C. pomonella* ; if its use becomes necessary, it should be applied only in one or two very early sprays on varieties known to be resistant to oil injury.

THERON (P. P. A.). **Rearing *Euxoa* on artificial Media.**—*J. ent. Soc. sthn Afr.* **8** pp. 165–166, 1 ref. Pretoria, 1945.

Laboratory experiments on the rearing of *Euxoa subalba*, Wlk., which is an important pest of potatoes in the Cape Flats, were made in 1944 by a technique similar to that used for *Argyroplote leucotreta*, Meyr. [*R.A.E.*, A **28** 641]. The medium employed was maize meal moistened with 60 per cent. of its volume of water in 1-lb. honey jars, and it was sterilised at 20 lb. pressure for 30 minutes and then inoculated with a nutritive fungus. The eggs, which were laid on muslin or waxed paper, were sterilised in 4 per cent. formaldehyde before being introduced by aseptic means into the jars ; 8 per cent. formaldehyde, which has little effect on the eggs of *A. leucotreta*, killed many of those of *E. subalba*, and a 0.1 per cent. solution of mercuric chloride killed almost all. *Mucor* and *Rhizopus* proved suitable for inoculating the medium, but the presence of *Aspergillus*, *Penicillium* or bacteria was harmful. The larval stage lasted about 30 days at 80°F., and a maximum of 11 fully fed larvae was obtained per jar. Owing to the size of the larvae and their tendency to feed on the surface of the medium, they usually became overcrowded when about an inch long ; when this occurs, some should be removed to fresh medium on which the nutritive fungus is already established. Fresh medium should be provided every four days, since contamination with other fungi and bacteria renders it unsuitable after longer periods. The fully developed larvae were no smaller than those reared on natural foods, such as cabbage. The fully fed larvae or young pupae should be transferred to damp soil, since the high moisture content of the medium caused high mortality among pupae left in it. No major abnormalities were observed among the moths obtained.

ULLYETT (G. C.). **Streptococcal Septicaemia of Cutworms.**—*J. ent. Soc. sthn Afr.* **8** pp. 166–167, 2 refs. Pretoria, 1945.

Laboratory stocks of larvae of *Euxoa* spp. in South Africa are sometimes affected by a disease caused by a typical *Streptococcus* that occurs in short chains or in masses in the body fluid. The symptoms comprise a gradual reduction in feeding, a change in the colour of the ventral surface of the larva from dark green to china white and in the texture of the skin, which becomes

tough and leathery, and sluggishness followed by death. The body of the dead larva is completely filled with the organisms, which are released into the soil by the rupture of the skin. Healthy larvae could be infected artificially only by means of hypodermic injection of a culture, and it is therefore suggested that infection takes place in the field through abrasions in the soft cuticle during ecdysis. Phagocytosis occurred in the blood, but there was no definite indication of immunity. Older larvae were more susceptible than young ones. Infection is favoured by high temperatures and moist sandy soil, and was more frequent in cages containing growing food-plants that required frequent watering than in cages with dry soil in which fresh food was introduced daily. Preventive measures comprise sterilising the cages and all the soil used, and the use of dry, loamy soil containing little sand. Suspensions of the organism might be of value against field populations where the soil is moist and contains a high proportion of coarse sand.

**GUILHON (J.). Propriétés insecticides des isomères de l'hexachlorocyclohexane.**—*C. R. Acad. Agric. Fr.* **32** no. 18 pp. 754-760. Paris, 1946.

The results are given of laboratory tests in France, some of which are noticed elsewhere [*R.A.E.*, B **37** 33], which show that while the  $\gamma$  isomer of BHC (benzene hexachloride) is the most toxic of the four known isomers to many insects [*cf.* A **33** 256; **35** 420], the other three also possess insecticidal properties.

When adults of *Leptinotarsa decemlineata*, Say, taken on potato leaves in August, were left in contact for five minutes with each of the four isomers and with a sample of technical BHC that had shown superior toxicity and were subsequently kept in ventilated boxes without food, the  $\gamma$  isomer and technical BHC both caused complete paralysis in three hours and complete mortality in 54 hours, though the technical product proved superior in individual tests, while the  $\alpha$ ,  $\beta$  and  $\delta$  isomers gave, respectively, 80, 90 and 80 per cent. mortality and 20, 10 and 20 per cent. paralysis in five days, as compared with 10 per cent. mortality and 50 per cent. paralysis in the same period in the controls. To test the fumigant effect, adults of *L. decemlineata* were kept under glass jars in which an open tube containing one of the isomers or the technical BHC had been placed. Both the  $\gamma$  and technical BHC gave complete paralysis in three hours and complete mortality in 54 hours, and the  $\beta$  and  $\delta$  isomers gave complete mortality in seven days, as compared with 60 per cent. mortality and 10 per cent. paralysis in the controls. The  $\alpha$  isomer gave 90 per cent. mortality and 10 per cent. paralysis in seven days, and 5 per cent. of the beetles were still alive after ten days.

In tests in which insects belonging to various orders were confined on papers on which a little of the  $\gamma$  isomer had been sprinkled and removed when they were paralysed, the respective times after which paralysis and death were observed were 28 hours and six days for *Rhaphigaster*, 0.5 and 18 hours for *Satyrus*, 32 minutes and 26 hours for *Anax*, 6-6.5 and 22-23 hours for two species of *Oedipoda* and 50 minutes and 10 hours for *Vespa crabro*, L.; *V. germanica*, F., was exposed to both the  $\gamma$  and the  $\beta$  isomer, and the respective periods were 40 minutes and 4.5 hours for  $\gamma$  and 4 and 13 hours for  $\beta$ .

The superiority of the technical BHC over the  $\gamma$  isomer observed in the earlier tests suggests that it may have contained either some hitherto unidentified isomers of still greater toxicity or one or more other toxic substances.

**BRU (M.). Nouveaux emplois insecticides de l'hexachlorocyclohexane.**—*C. R. Acad. Agric. Fr.* **32** no. 18 pp. 771-772. Paris, 1946.

Tests against various insects [*cf.* also *R.A.E.*, B **37** 34] were carried out with a sample of BHC (benzene hexachloride) in which the  $\gamma$  isomer predominated;

it was obtained by partly dissolving crude BHC in methyl alcohol, removing the solid residue and evaporating the solvent. A solution of 1 per cent. BHC by weight in carbon tetrachloride, at 25 gm. per cu. m., gave complete mortality of grain weevils [*Calandra*] and Bruchids in a few minutes, whereas 200 gm. carbon tetrachloride was required to achieve the same result in 24 hours. *Calandra* and the Bruchids were all killed in a few minutes by 1 per cent. BHC in trichlorethylene, applied as an atomised spray. A solution of 0.2 gm. BHC in a mixture of 20 cc. trichlorethylene and 80 cc. carbon tetrachloride gave complete mortality of *Calandra* in grain and Bruchids in dried pulses in less than two minutes when sprayed on to the seeds in a closed space at 1 cc. per kg., and in three minutes when atomised on to them at 12 gm. per cu. m. The treated grain had a slight odour, which disappeared after airing, and its germinative power was not affected. No taint was detected in the treated pulses. The same solution, with the addition of 0.1 gm. paradichlorobenzene per 100 cc., sprayed or atomised, killed all stages of clothes moths and gave temporary protection of the treated fabrics. Bruchids, *Calandra* and house-flies all died within 12 hours after contact with walls that had been painted with 4 per cent. BHC by weight in linseed oil.

PUSSARD (R.). **Remarques sur deux thrips des cultures florales.**—*C. R. Acad. Agric. Fr.* **32** no. 18 pp. 772–775, 6 refs. Paris, 1946.

Investigations in 1946 showed that the thrips responsible for damage to greenhouse carnations on the French Riviera [cf. *R.A.E.*, A **37** 9] was *Taeniothrips dianthi*, Priesn., which had not previously been recorded on carnations in southern France, and not *T. vulgarissimus*, Hal., as had been expected [cf. **13** 164; **22** 509]. All the adults taken between June and October were females, and the characters distinguishing them from *T. vulgarissimus* and other species of the genus are briefly indicated. Further results of the control experiments [**37** 9] are given in a table. The numbers of marketable blooms obtained between 8th October and 24th November from carnation plants grown in a greenhouse in which *T. dianthi* was almost the only pest were 0 for the nicotine-sulphate spray, 292 for the 1 per cent. suspension of benzene hexachloride, 248 for the 1 per cent. suspension of DDT, and 207 and 187, respectively, for the emulsified solutions containing 0.25 and 0.5 per cent. DDT.

*Gladiolus* is being increasingly grown in the Alpes-Maritimes and Var, from corns originating largely from the United States. Damage to the leaves and floral spikes of plants at Antibes was caused in July–November 1946 by a species of *Taeniothrips* closely resembling the American *T. simplex*, Morison (*gladioli*, Moul. & Stnw.), a pest of *Gladiolus* in the United States and many other countries, and *T. atratus montanus*, Priesn., which has also been recorded on *Gladiolus* [cf. **20** 225]. The author considers that it may be a new species, provisionally names it *T. gladiolicola*, and indicates the characters that distinguish it from the other two. All the examples taken were females, and a few of them were found on the flowers of carnations growing near heavily infested *Gladiolus*. Promising control was obtained with dusts containing 4 per cent. DDT or 10 per cent. benzene hexachloride in talc, applied on 10th October.

RÉGNIER (R.). **Les recherches sur les hannetons. Doit-on continuer à préconiser le hannetonage ?**—*C. R. Acad. Agric. Fr.* **32** no. 18 pp. 799–804, 1 ref. Paris, 1946.

A field laboratory for the study of *Melolontha melolontha*, L., was set up at Saint-Saëns (Seine-Inférieure) in 1946. It was in operation from April to October, and the results of the work, many of which confirmed previous

observations in the region [*R.A.E.*, A 30 372], are here reviewed. It is proposed that the numbers I, II and III should be used to designate the broods of which the adults fly in years divisible by 3 with remainders of 1, 2 and 0, respectively; brood II predominates in France, particularly in the main agricultural regions. Flights were very heavy in Normandy in 1940, 1943 and 1946 and lasted for about a fortnight in late April and early May. As the beetles prefer succulent foliage, cherry, plum and chestnut are attacked first and other trees later. In 1946, oviposition did not begin until 29th May, owing to cold weather, and continued until 20th June or later. Dissected females did not contain more than 28 eggs, and 60 and even 80 per cent. of the females in some lots were sterile.

It is considered that the practice of collecting and destroying the beetles as soon as the flight period begins, which is the only method of control recognised, requires a disproportionate amount of labour and is not very effective, since the beetles collected are mostly males [*cf. loc. cit.*] and many of the females are sterile or die without ovipositing. The numbers collected, though large, are not large enough to make much difference to the subsequent infestation by larvae, and the practice did not lead to a reduction in damage at Saint-Saëns in 1944 and 1945, following the flights in 1943, or in the number of adults in 1946, although in some districts where it was not carried out there was a reduction. It can now largely be replaced by insecticidal treatment [*cf. next two abstracts*], though collection in the early morning is still of some use to prevent defoliation in plum and cherry orchards.

VIEL (G.). **Etudes de laboratoire sur l'efficacité de substances chimiques envers les hannetons** (*Melolontha melolontha*) **et leurs larves.**—*C. R. Acad. Agric. Fr.* 32 no. 18 pp. 804–807, 5 refs. Paris, 1946.

In the laboratory tests described, newly emerged adults of *Melolontha melolontha*, L., that had been collected from the soil were caged separately and allowed to feed on leaves of poplar that had been dusted or sprayed with the insecticides under test. For the dusts, the percentages dead in five and (in brackets) ten days, during which time there was no mortality in the controls, were 50 (100) for 5 per cent. BHC (benzene hexachloride), 30 (100) for 5 per cent. sulphur derivatives of BHC [polychlorocyclane sulphide (*R.A.E.*, A 35 313)], 0 (20) for 5 per cent. monochlorophenylpentachlorethane, 0 (20) for 25 per cent. phenothiazine and 0 (0) for 5 per cent. tetrachlortetraphenylethane, 1 per cent. dinitro-*o*-cyclohexylphenol and 20 per cent. derris powder, while for the sprays they were 20 (70) for 1.6 per cent. lead arsenate (11 per cent. As), 0 (0) for 0.5 per cent. diphenyl sulphide, and 33 (92) for 0.9 per cent. DDT, which eventually gave complete mortality in 12 days. BHC, its sulphur derivatives and DDT all caused prompt cessation of feeding, while lead arsenate caused an almost immediate cessation.

In further tests, larvae of *M. melolontha* were placed in lots of ten in flower-pots containing dry, sifted soil that had been thoroughly mixed with an insecticidal dust and a clump of grass was planted in each; the concentrations were equivalent to those that would be obtained by applying the insecticide at rates of 18 or 90 lb. per acre and working it into the soil to a depth of four inches. Carbon bisulphide was tested at a rate equivalent to 720 lb. per acre by introducing the liquid at a depth of about four inches and placing wire gauze over the zone of high concentration to prevent the larvae from entering it. The percentages dead in seven and (in brackets) 18 days were 35 (72) for DDT, 19 (62) for BHC and 14 (74) for sulphur derivatives of BHC when application was equivalent to 18 lb. per acre, as compared with 16 in seven days in the control, and 27 (36) for allyl isothiocyanate in bentonite at 18 lb. per acre and 68 (100)

for BHC and 46 (76) for DDT at 90 lb. per acre, as compared with 9 in seven days; BHC exercised a marked repellent effect. Carbon bisulphide gave 93 per cent. mortality in seven days, as compared with 40 per cent. in the control.

RÉGNIER (R.) & ARNOUX (J.). **Recherches sur la biologie des vers blancs de première année (*Melolontha melolontha* L.). Etude des moyens de lutte.**—*C. R. Acad. Agric. Fr.* **32** no. 18 pp. 807–811. Paris, 1946.

Part of the work on *Melolontha melolontha*, L., at Saint-Saëns in 1946 [*cf.* *R.A.E.*, A **37** 61] consisted of observations on oviposition, the distribution of the newly hatched larvae, and their control by insecticides. The eggs were laid in June in groups of up to 20 at an average depth of two inches and hatched in 4–6 weeks, but the newly-hatched larvae did not become evenly distributed in the soil until the end of August. Counting the larvae turned up by the plough gave a very erroneous picture of the total population and was much inferior to the examination of soil samples. The numbers found per square yard by the latter method in various types of soil varied from 2.5 to 98, with an average of 33. The counts appeared to indicate that the number of eggs laid decreases as the land is more densely covered with vegetation. Only 2.5 larvae per square yard were found in fields of beet, which receive cultural treatment about the time of oviposition, and very damp soil and dry, sandy soils also showed very few. Descent to the lower layers for overwintering began about mid-October, but many larvae were still found about the roots of grasses in mid-November.

When gravid females were offered pairs of frames containing, respectively, untreated soil and soil treated with BHC (benzene hexachloride), polychlorocyclane sulphide [**35** 313], DDT or naphthalene at various dosages, they tended to avoid the treated soils. When larvae were introduced into the frames and provided with tufts of grass for food, BHC and polychlorocyclane sulphide killed them more quickly than DDT, and all were more effective in solution than as dusts.

Further tests were carried out in grassland that was found in early September to be infested at the rate of 418 larvae per square yard and had become unfit for grazing. On 4th September, various insecticides were applied to the soil in water at a rate equivalent to about 1,800 gals. per acre. Polychlorocyclane sulphide, as a paste containing 8.25 per cent. chlorine, diluted to 0.5 per cent., and as a soluble powder containing 2.75 per cent. chlorine, rich in active isomers and diluted to 1 per cent., and 1 per cent. of a BHC product containing 7 per cent. chlorine, caused 90 per cent. reduction in the numbers of larvae in three weeks and their complete disappearance in six weeks, with a noticeable regrowth of grass in the treated areas. DDT was less effective, possibly because the material used was unsuitable for soil treatment, while allyl isothiocyanate was useless at the rate applied. The numbers of larvae per square yard in untreated areas fell to 167 by 15th October but still exceeded 83 on 5th December.

A further test was begun on 9th October in which BHC or polychlorocyclane sulphide was mixed with a fertiliser (potassium chloride) and applied to untreated sections of the infested grassland after disking. The actual rates of application were 18 and 13.5 lb. per acre for BHC and 18 and 9 lb. for the sulphide, and the plots were disked and rolled after treatment. Results had not been obtained at the time of writing, but it was feared that the work had been begun too late, since the larvae had begun to leave the surface layers for the winter.

SCHNEIDER (F.) & BOVEY (P.). **Die San José-Schildlaus *Quadraspidiotus perniciosus* Comst.**—24 pp., 2 col. pls., 8 figs. Berne, Eidg. Drucks.-u. MatZent. [? 1947]. Price 90 cts.

This booklet was compiled in view of the danger of the spread of *Quadraspidiotus perniciosus*, Comst., to Switzerland [*cf.* *R.A.E.*, A **33** 125;

**35** 146, 201]. It contains a key to the principal Diaspine Coccids found on the bark or fruits of fruit trees in Europe, accounts of the morphology, geographical distribution, life-history and food-plants of *Q. perniciosus*, the damage that it causes to fruit trees and the ways in which infestation is spread, and a summary of the measures taken to prevent its introduction, which were embodied in legislation passed on 30th April, 1946.

The regulations require all consignments of living woody plants or parts of them (except conifers) and all fresh pip, stone and berry fruits for import to be accompanied by a certificate stating that they are free from infestation and originate from an uninfested locality. They are subject to inspection at the frontier, and any material found to be infested is refused entry. Fruits that have passed the inspection are admitted without fumigation, but plant material, with the exception of certain specified plants, must be fumigated. Tree nurseries in the interior are to be inspected annually and orchards in susceptible districts at regular intervals. Any case of infestation is to be reported and appropriate control measures are to be carried out under supervision.

Foci of infestation were found in the summer and autumn of 1946 in the Cantons of Ticino and Valais and in a nursery in the Canton of Berne. All were eradicated. The control measures to be employed and those adopted in other countries are briefly reviewed.

**Bekämpft die Blattläuse in Saatkartoffellagern.** [Control Aphids in Stores of Seed Potatoes.]—*Grüne* repr. 3 pp., 2 figs. Zurich [? 1947].

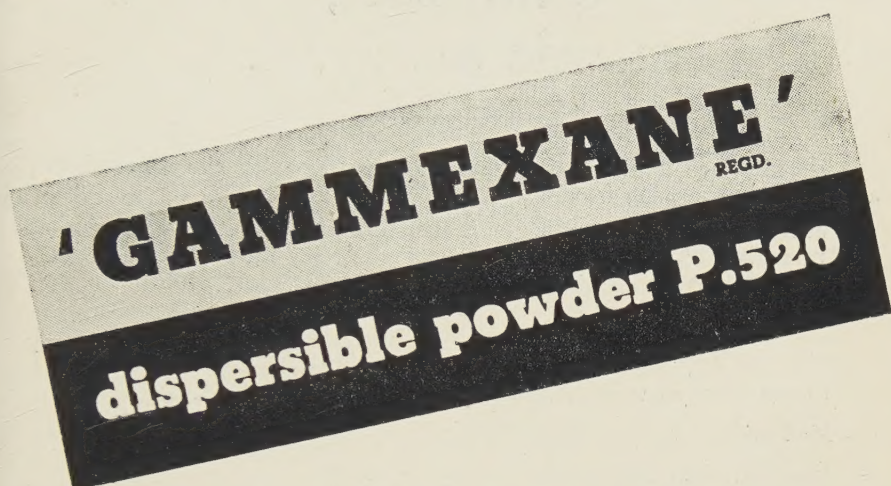
Measures for the prevention of virus infection in seed potatoes have mostly been concerned with the control of Aphids on the field crop, and little attention has been paid to the stored tubers. Investigations at Lausanne have shown, however, that Aphids occur on them during the winter more frequently than has been thought. They are present in autumn in the hollows of the eyes and feed on the shoots. They do not damage the shoots much, but since conditions in the storage premises sometimes favour their rapid reproduction, especially towards the spring, migration to uninfested tubers occurs, with many opportunities for virus transmission. The commonest of the three species observed is *Rhopalosiphoninus latysiphon*, Davidson, which has only recently been recorded in Switzerland, but it has not been definitely shown to be a virus vector [cf. *R.A.E.*, A **27** 578]. It is known to overwinter on the tubers of potato and similar parts of flowering plants in Holland, and builds up large populations on the underground parts in summer. *Myzus persicae*, Sulz., is somewhat less common, but is the chief vector of potato viruses, and *Macrosiphum solani*, Kalt. (*Aulacorthum pseudosolani*, Theo.), which mainly infests sprouting tubers, is a vector of leaf-roll [*Corium solani* of Holmes]. The control measure recommended is fumigation with nicotine candles at the beginning of winter, and again at the end of February or the beginning of March.

#### PAPERS NOTICED BY TITLE ONLY.

CRISTOL (S. J.), HALLER (H. L.) & LINDQUIST (A. W.). **Toxicity of DDT Isomers [o,o'-,o,p'- and p,p'DDT] to some Insects affecting Man.**—*Science* **104** no. 2702 pp. 343-344, 4 refs. Lancaster, Pa., 1946. [See *R.A.E.*, B **37** 33.]

HASEMAN (L.). **Controlling Insect Pests of Melons, Cucumbers, and related Crops** [in Missouri].—*Bull. Mo. agric. Exp. Sta.* no. 391, 2nd edn., 16 pp., 6 figs. [Columbia, Mo.] 1946. [See *R.A.E.*, A **26** 269.]

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